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The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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A Modest Pioneer

At the advanced age of 89, Mr. F. W. Finch, the founder of the Institute of British Foundrymen, has passed away. In 1902, he wrote to the Editor of this JOURNAL, immediately after publication of its first issue, and suggested that there was a real need for an institute to be created to cater for British foundrymen in a manner similar to the American Foundrymen's Association. This body had been created in 1896 through the effort of Mr. John A. Penton and the late Dr. Moldenke. After several months of Press propaganda and the writing of numerous personal letters, Mr. Finch finally decided that sufficient interest had been created to call a meeting in Birmingham at which less than a dozen enthusiasts participated. Most people would have been deterred from taking further action, but Mr. Finch was impressed with the enthusiasm of his supporters, especially the late Mr. Robert Buchanan, the late Mr. J. Ellis and Mr. F. J. Cook, all of whom later became Presidents. Mr. Cook, it is interesting to recall, was one of Mr. Finch's apprentices, and, according to Mr. Finch's oft-repeated story, was a "little monkey." Mr. Finch's early efforts soon received the very valuable support of Dr. Longmuir and Dr. Swinden. Progress was never spectacular, but invariably steady. Mr. Finch knew more about trade-union organisation than the type of organisation associated with the great technical institutes, so he promptly organised branches in the different areas, an action which has been followed by many of the older bodies. He invariably attached the greatest importance to the co-operation of the Institute with the JOURNAL, recognising as he did the pioneer work the latter had undertaken. It was obvious that later in life he was somewhat overawed at the size and importance of the Institute he had created, and delighted in recalling its earliest work and the enthusiasts who had been associated with him.

In no way did he resemble the accepted type of pioneer, as he was of an extremely modest and retiring disposition. He never sought high office, and once he had seen the organisation safely launched, he was content to maintain a watching brief over the interests of the Institute. The last time Mr. Finch participated in a meeting of the Institute was in 1933 in Cardiff, when a special medal was established for "meritorious service" and awarded to him. Mr. Finch will go down in history as a man who had the vision and energy to create for the British foundry industry a technical organisation which has been honoured by the Privy Council with the grant of a Royal Charter, and which is recognised by the Government as being a body working successfully and disinterestedly for the good of industry as a whole.

Cast Iron under Combined Stress.—2

We referred last week to the rather remarkable result recorded in the recent Paper by Dr. Gough and Mr. Pollard, in which a somewhat brittle cast iron broke under fatigue at a strength as high as its static tensile strength, giving an endurance ratio equivalent to unity. It is not likely, of course, that tougher irons will give so high a figure, but it is perhaps not surprising that such a material should, as one contributor to the discussion suggested, not be susceptible to fatigue. Mr. J. G. Pearce, the Director of the British Cast Iron Research Association, suggested that the result might be looked at in this way; that the fatigue strength was not unusually high, but that the static strength was low, and he pointed out that all cast-iron fractures resembled fatigue fractures, being, in fact, primarily notch failures, starting at one of the many graphite cavities. Such a view would suggest that cast-iron behaves better in service than would be expected from a design based on static strengths, and, indeed, this is consistent with the facts, for failures in service are surprisingly few considering the brittle nature of cast iron. The same speaker showed, however, that although in a sound engineering iron the plastic part of transverse deflection is about one-fifth of the total, it might reach one-third in a very good iron. In the brittle iron tested in the Paper this portion was only one-tenth, while in an austenitic iron of the ductile type it might reach three-fourths, and the higher this proportion the greater is the impact strength. This appears to offer a means of distinguishing readily between tough and brittle irons. The relation of this factor to fatigue strength has still to be worked out.

Of the various theories of failure, it seems from Gough and Pollard's results that some materials fail according to one and some according to another; that, in fact, they may within certain limits all be right. The cast iron failed according to the theory of failure by principal (tensile) stress. Not the least important part of the Paper for an engineering audience was the statement that the results on the cast iron exhibited a remarkable and surprising degree of uniformity, and no less than seventy-eight specimens were tested. The results on the other irons will be keenly anticipated.

XUM

British Cast Iron Research Association Study Course

Over one hundred members registered for the second B.C.I.R.A. Study Course held in Birmingham on November 6, 7 and 8. During the mornings sixteen talks were given by twelve members of the staff, together with one by Prof. H. L. Riley, of Newcastle-upon-Tyne. During the afternoons visits to works were made and demonstrations were held in the laboratories and on the B.C.I.R.A. cupola. On November 6 an informal dinner was held.

Following a visit to the works of the British Thomson-Houston Company, Limited, Rugby, where twin balanced-blast cupolas were seen in operation, Mr. H. B. Weeks, chairman of Council, thanked the company for opening the works and for their hospitality, particularly Mr. A. P. Young, Mr. Coales, Mr. Morgan, foundry manager, and Mr. W. B. Parker; and the three last-mentioned gentlemen suitably responded. A visit was also paid to the works of the Audley Engineering Company, Limited, Newport, Shropshire, where a balanced-blast cupola and a Stein & Atkinson oil-fired furnace were seen in operation. The party were subsequently entertained to tea, and a vote of thanks was proposed by Mr. F. J. Cook, and Mr. R. W. Leach, managing director, responded. The Detroit-Birlec rocking-arc furnace was seen in operation at the works of the Birmingham Electric Furnaces, Limited, on a synthetic cast iron made from steel scrap, cast-iron borings and ferro-alloys. The visitors were received and entertained by Mr. J. H. Crossley and Mr. A. G. Robiette, and thanks were expressed to the company by Mr. J. G. Pearce, to which Mr. Crossley responded. Another party visited the works of the British Piston Ring Company, Limited, Coventry, seeing in operation a similar rocking-arc furnace and a Stein & Atkinson oil-fired rotary furnace, and Mr. T. R. Twigger responded to a vote of thanks to the company and to Mr. W. A. Oubridge.

Foundries in Shanghai

According to Mr. A. H. George, acting commercial counsellor at Shanghai, in his Report on Trade and Economic Conditions in China, the total number of foundries in Shanghai now exceeds 300. The great majority of these are small concerns, with a capital of a few thousand dollars, and the largest has a capital of less than one hundred thousand dollars. The products are mainly parts for machinery makers, nuts, screws and bolts, and pipes. Workshops and foundries maintained by some of the railways and dockyards are particularly well equipped, both for repairs and for construction work, and a few of the privately-operated foundries are also in a position to accept important contracts. The Ministry of Railways recently placed an order with a Shanghai firm for a hundred 40-ton box cars to be built locally to government specifications. It is, however, not only in Shanghai that machinery and metal wares are produced. Foundries and machine shops exist all over China, and tend to multiply. They do not as a rule specialise on one product, but attempt to satisfy the entire local demand for cheap metal products which can be easily produced. An example is a factory set up at Changsha, using the buildings and some of the machinery of the former Hunan mint, some of whose products are agricultural implements, stoves, safes, electrical good, and kerosene oil lamp burners, all of which find a ready sale locally. A central machine works is being established near Shanghai for the manufacture of tubes, bolts and nuts, galvanised sheets, castings and certain small machine tools. The machinery is being purchased in the United Kingdom with money furnished from Boxer Indemnity funds.

The Report is obtainable from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price 3s. net.

District Presidents.—No. 2

BIRMINGHAM, COVENTRY AND WEST MIDLANDS BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN

MR. G. M. CALLAGHAN, the new President of the Birmingham, Coventry and West Midlands Branch, received his technical education at Chesterfield Technical Schools and I.C.S., where he was awarded the diploma for foundry practice. He began his career as an apprentice in the foundry of Messrs. Green's, Limited, Chesterfield, and subsequently gained experience with the Sheepbridge Coal & Iron Company, Limited, the Bryan Donkin Company, Limited, and other foundries in the Chesterfield and Sheffield districts. During the war Mr. Callaghan served

MR. G. M. CALLAGHAN.

in France with the Sherwood Foresters. In 1925 he was appointed to his present position of iron-foundry manager at H. Pontifex & Sons, Limited, the well-known brewers, refrigeration and chemical engineers, and four years ago he was also given charge of the non-ferrous foundry. Mr. Callaghan joined the Sheffield Branch of the Institute of British Foundrymen in 1924, and was elected a member of the Birmingham Branch Council four years later. In 1931 he was awarded the diploma of the Institute.

The Action of Cold Water in Metal Corrosion

The leading German technical and scientific associations, who united to form a joint council in connection with corrosion and its prevention, have decided to hold the fifth annual Congress in Berlin on November 18-19 of this year. At the previous meetings, corrosion was dealt with very broadly, a variety of Papers being presented, but this time it has been decided to confine the attention of the Congress to one particular theme: "The corrosion of metallic materials of construction by cold water." This subject is of vital importance in all branches of industry, but particularly is it of interest to gas and water engineers, and industries concerned with the disposal of effluents, more particularly from chemical works. A number of questions of technical and economic importance will be dealt with for the first time, the various speakers being experts on their particular subjects. In addition to the Papers of more general interest, such as those dealing with the damage done by water corrosion, and the methods employed for its prevention, it is proposed to present Papers dealing with rapid methods for the determination of rate of corrosion, and the standardisation of the laboratory equipment and methods of expressing the results of corrosion tests. The administration of the Congress has been entrusted to the Verein deutscher Chemiker, Berlin, W.35, Potsdamer Str. 103a.

Random Shots

Do you know who makes the Old Man brand of brass sheets? This was a query sent in by a city firm of merchants, and it was not surprising that most sources of information for this character of inquiry failed, because the final analysis revealed it to be a nickname used extensively in India for the Neptune Brand, of the I.C.I. Metals, Limited, but whether Brown Brothers of Blaina organised the first British brass band (another inquiry actually received last week) is still bothering Marksman.

* * *

Amongst the minor Silver Jubilee celebrations was a banquet organised by one of the large mental hospitals, and amongst those present in addition to the medical staff and board of governors were a few of the more stable patients. To one of these was entrusted a toast which involved a review of the general progress made since the beginning of King George's reign. He gave a masterly oration covering invention, and its material and psychological influences, economic developments, quantity production, and the repercussions of foreign political activities. The chairman, after the applause had subsided, very warmly complimented the speaker on his erudition, lucidity of expression, and brilliant delivery. This caused the proposer to rise again with a request that he wished to strike a personal note and to say that every word he had uttered was a direct inspiration from the Almighty. Here he was brusquely interrupted by a voice, which shouted: "Shut up, you liar, I haven't spoken to you for a week!"

* * *

A candidate on being asked by a heckler why his wife wore such a magnificent fur coat, told the following story: Well, Sir, having won the office pontoon football sweepstake, I treated the missus to a stall at the theatre, but unfortunately occupying a seat immediately behind her was an æsthetic young man, who was obviously worried because a pair of perfect shoulders was spoilt by the incidence of a bit of wool. He could not resist the temptation and attempted to remove it, only to find that it was replaced by a further strand. Then he became really busy, with the result that when my wife returned home her little woolly vest had completely disappeared, and fearing she would catch cold I bought her a nice fur coat. Next question, please!

* * *

Marksman is annoyed. Only this morning the corporation dustmen removed but one of his four tins of household *débris*, so, consulting the telephone directory, to his amazement he found it necessitated a toll call to reach the Council offices. Moreover this applies to about 90 per cent. of the inhabitants! Marksman can well imagine what would happen if such a condition existed in Barnsley, Blackburn or Preston North End. The local paper would be full of "Pro Bono Publico," "Disgusted," "Mother of Ten," and "Outraged" airing their views, but Marksman's fellow mutts in the south merely smile and pay up.

MARKSMAN.

Company Reports

Birmingham Small Arms Company, Limited.—Profit, £112,182; debit brought in, £69,714; debenture interest, £85,961; to sinking fund, £24,380; debit carried forward, £67,873. Meeting November 12.

Brown, Bayley's Steel Works, Limited.—Profit, £58,565; brought in, £25,515; dividend on the cumulative preference shares for the half-year to July 31, 1930, £12,500; further dividend on the cumulative preference shares for the two years to July 31, 1932, £50,000; carried forward, £21,581. Meeting November 12.

Progressive Mechanisation

A STUDY OF A WEST OF ENGLAND FOUNDRY

By VINCENT C. FAULKNER

It is of real interest to pay periodic visits to really progressive foundries, as an opportunity is afforded of learning something of the ambitions of the management and later of seeing their concrete exemplifications. A foundry coming into this category is that of Newman, Hender & Company, Limited, of Woodchester, in Gloucestershire, which it has been the writer's privilege to inspect on several occasions during the last five years, and on the last occasion it was thought that a stage in the evolution had been attained that rendered a description of this foundry of definite interest to the industry, as indicating how a number of processes can be mechanised to advantage without the necessity of revamping the entire buildings and existing organisation.

The works, which were established by the late Mr. S. J. Newman, J.P., the father of the present chairman, occupy a site which confers an extraordinary combination of advantages. For instance, the actual foundry shown on the lay-out (Fig. 1, page 364) is situated alongside a railway siding, connecting with the London Midland & Scottish and Great Western Railways, which is at the level of the cupola-charging platform, while the little river and pond over which part of the foundry buildings is situated provides an ample supply of water for a variety of purposes, including the driving of water turbines which help to augment the main power plant.

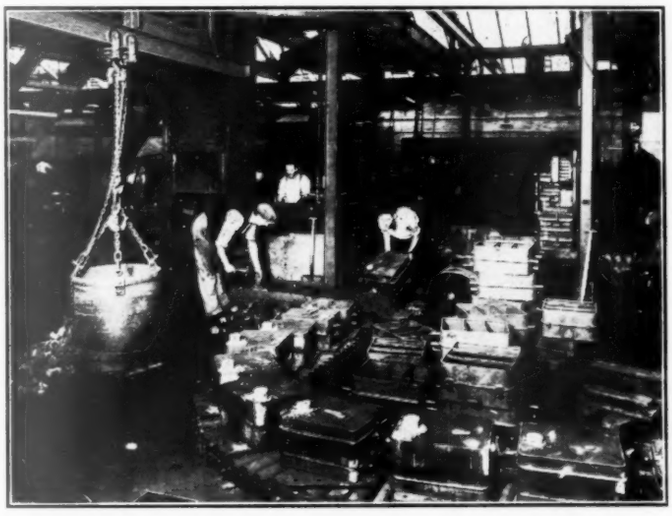

Fig. 2.—Showing the Knock-out by the side of the Sand Elevator and Mono-rail suspended Scrap Container.

Raw Materials

The incidence of levels is utilised to the full in the handling of raw materials, pig-iron, coke and sand being loaded from main-line trucks direct into bogie wagons running on light-gauge rails. It is but a few yards' journey for the wagons to reach either a platform weighing machine situated centrally between the two cupolas, or by means of turntables to pass over the sand bins (shown in Fig. 1), where, by a combination of loose plates and bottom-discharging wagons, sand-handling costs are reduced to negligible proportions. Because of the distance between some sources of supply and the Cotswold country, and in order to assure a constant and reliable service to customers, heavy stocks are carried. For instance, a minimum stock of pig-iron is held to be 500 tons, and, naturally, storage over and above that provided within the foundry buildings has been provided, and takes the form of a well-constructed loading dock and commodious shed alongside the siding.

Iron-Melting Plant

There are two 30-in. inside diameter Whiting cupolas available. They each carry four tuyeres, and are fan blown by 8-h.p. motors. The blowers are situated on the charging platform, between the two cupolas. The metal is tapped into a large mixing ladle, and thence transferred to hand shanks. To enable the moulds within the mechanised plant area to be cast, sections of the roller conveyor paths are hinged to provide an access. The shanks are lined and dried beneath a lean-to attached to the core-shop wall, where a coke brazier is so arranged that the top and sides can be used simultaneously. Three standardised metal mixtures have been developed, which completely meet all normal requirements.

Sand Preparation

The sand system deals with about 30 tons per hr. The cast moulds arrive at the knock-out shown in Fig. 2 by means of a length of roller conveyor installed at either side of a battery of moulding machines. This knock-out consists of a stout 8-ft. by 3-ft. screen which is hinged at one end for ease of cleaning, the reciprocating action being produced by a cam arrangement at one end, the whole being mounted on needle bearings. The sand falls through the sieve into the boot of a vertical bucket elevator enclosed in a sheet-steel casing. This casing has an opening near the bottom and another near the top, the idea being to create a chimney-like draft effect having for its object the cooling of the hot sand which has just left the moulds. The buckets are of malleable cast iron and measure 8 in. by 4 in. The speed of the elevator is 235 ft. per min. The elevator spills on a short length of conveyor belt which terminates in a magnetic pulley. The scrap metal ("tramp iron") so recovered falls down a shute to floor level to fill a container for removal. The sand, now freed from iron contamination, feeds a sand-disintegrating machine of the "thrower" type and the stream so ejected is directed on to the main sand-distributing belt by means of a sheet-metal enclosed shute. Into this thrower water is introduced, and is controlled between 4 to 5 per cent., a "Speedy" tester being used for the purpose of making frequent tests. The distributing belt, shown in Fig. 3, which is of the usual heat-resisting type, is 18 in. wide and 90 ft. between centres. It runs at 150 ft. per min. The ploughs are of a type we have not previously encountered. They take the form of a V, the acute angles of which meet the stream of sand, and, being adjustable in both the vertical and horizontal planes, deflect the sand towards the entrance to the particular hoppers to be filled at any particular moment.

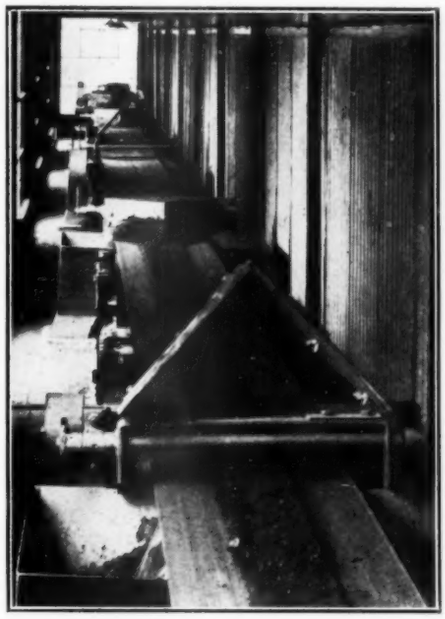

Fig. 3.—The Sand-Distribution Belt, showing type of Plough used.

The hoppers, which are of the usual sand-storage type, are provided with vibrators, so that no excuse exists for rapping with any loose implement handy should any trouble arise from sticking. This sand is used as backing sand only. At the end of the belt are two shutes for providing sand for machines not placed within the area enclosed by the mechanised plant.

Facing Sand

Facing sand is prepared in two "Rotoil" mixers at the position shown in Fig. 1. These machines are so adapted that a quantity of 5 cwts. is prepared in each batch and fills specially-designed wheeled bogies, a sketch of which is given in Fig. 4. These bogies arriving at the mixers with sand to be treated are lifted and emptied into the mixers by means of an air-operated hoist and are subsequently transferred to convenient positions beside each moulding machine.

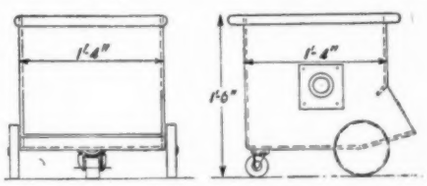

Fig. 4.—Type of Portable Bin used for Transporting and Storing Facing Sand.

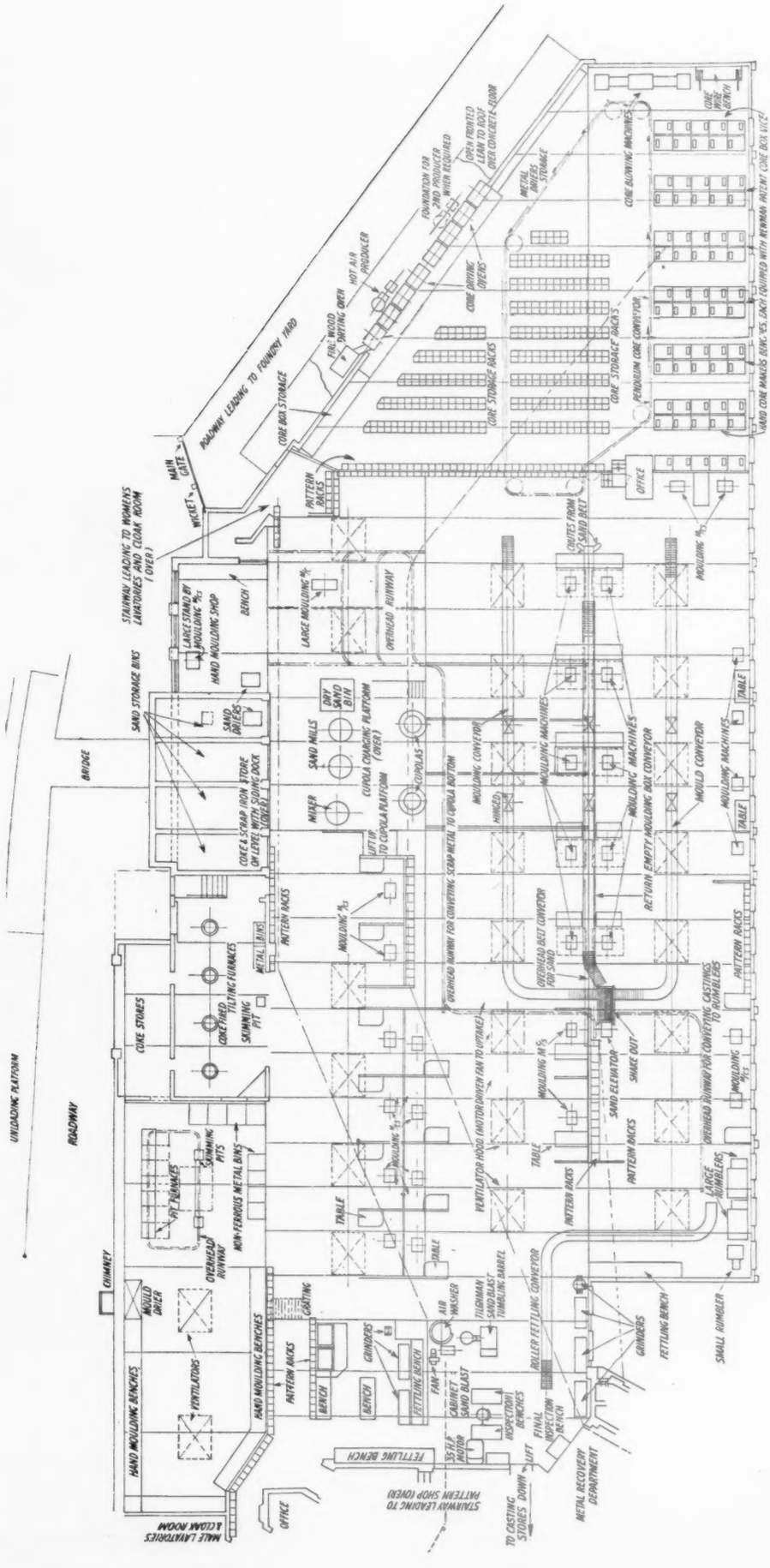

FIG. 1.—GENERAL LAY-OUT PLAN OF THE FOUNDRIES OF MESSRS. NEWMAN, HENDER & COMPANY, LIMITED.

Moulding Plant

The general appearance of the moulding plant is shown in Figs. 5 and 6. Beneath the sand-distributing belt, which is located in a gantry above the foundry roof and served by the aforementioned hoppers, are ten moulding machines, including plain jolt-squeeze rammers and jolt-squeeze turnovers, all of which work in pairs. Empty moulding boxes are served back to the machines from the shake-out by means of a third roller conveyor running the length between the machines (see Fig. 1). The floor area between the moulding machines and the roller conveyors will accommodate between 600 and 800 moulds. Here they are cored-up, cast and, after allowing a period for cooling, are placed on the roller conveyors and sent along to the knock-out.

In addition to the machines centrally installed and constituting the basis of the mechanised plant, there is a large isolated jolt-turnover machine. This receives its backing sand from one of the shutes situated at the end of the sand-distributing belt. This sand is fed into a sand-mixing and aerating machine of the thrower type which ejects the stream at high speed up a sheet-metal shute to fill a hopper placed above the machine. In addition there are eight small hand-operated moulding machines situated along the wall of the foundry opposite the cupolas. Whilst both "Sterling" steel and iron boxes are used, a commendable effort is made to limit the number of sizes in use and virtually the whole of the production is covered by four types to be referred to later.

Core Making

As the core department has to deal with between 60,000 and 80,000 cores per week, it can be well imagined that the organisation of this department is a matter of very considerable importance. It would perhaps be a little unfair to deal here with its development in any great detail, as Mr. Noel Newman is to present a Paper upon coreshop cost reduction to the London Branch of the Institute of British Foundrymen in the early spring.

A "Rotoil" core-sand mixing machine is used for the preparation of the sand mixtures and the same type of wheeled bogies are used for conveying the mixture to the sixty odd girls employed in the department—views of which are shown in Figs. 7 and 8. These bogies are placed at the end of each bench and from these the operators draw their supplies. Aluminium-alloy coreboxes are used, and the cost of maintenance of these was so heavy that the "Newman" air-operated corebox vice was developed. Its construction and operation has previously been described in our columns. There are two core-blowing machines in use (see Fig. 7), each operated by two boys, and each machine producing approximately 1,500/2,000 cores per day. All cores are placed on standard-sized plates, which are transferred to a pendulum-type conveyor. The trays are suspended at distances of 8 ft., and there is room for a much closer spacing should developments warrant. Springs (shock absorbers) are introduced in the vertical arms of the pendulums, and so successful has this been that shaped carriers have been dispensed with except in the case of those cores produced in oil sand by the blowing machines.

The conveyor carries the cores to a series of batch drying ovens, a general view of which is shown in Figs. 9 and 10. Altogether there are eight ovens, the chambers of which are 4 ft. 10 in. high by 4 ft. 4 in. wide by 2 ft. 6 in. deep, standing on short legs (see Fig. 9), which have been divided into three portions by vertical racks and stays with small ¾-in. angle-iron slides placed at 1½-in. pitch, so that the whole chambers can be completely filled with core trays, according to the core sizes, and no available space is wasted. Fig. 10A shows the detailed arrangement of the stoves.

The ovens, which are all internally insulated by asbestos mattresses, are heated by clean CO_2

Fig. 5.—The Cupola Side of the Moulding Plant, showing the Hinged Portion of the Roller Path and the Ventilation System.

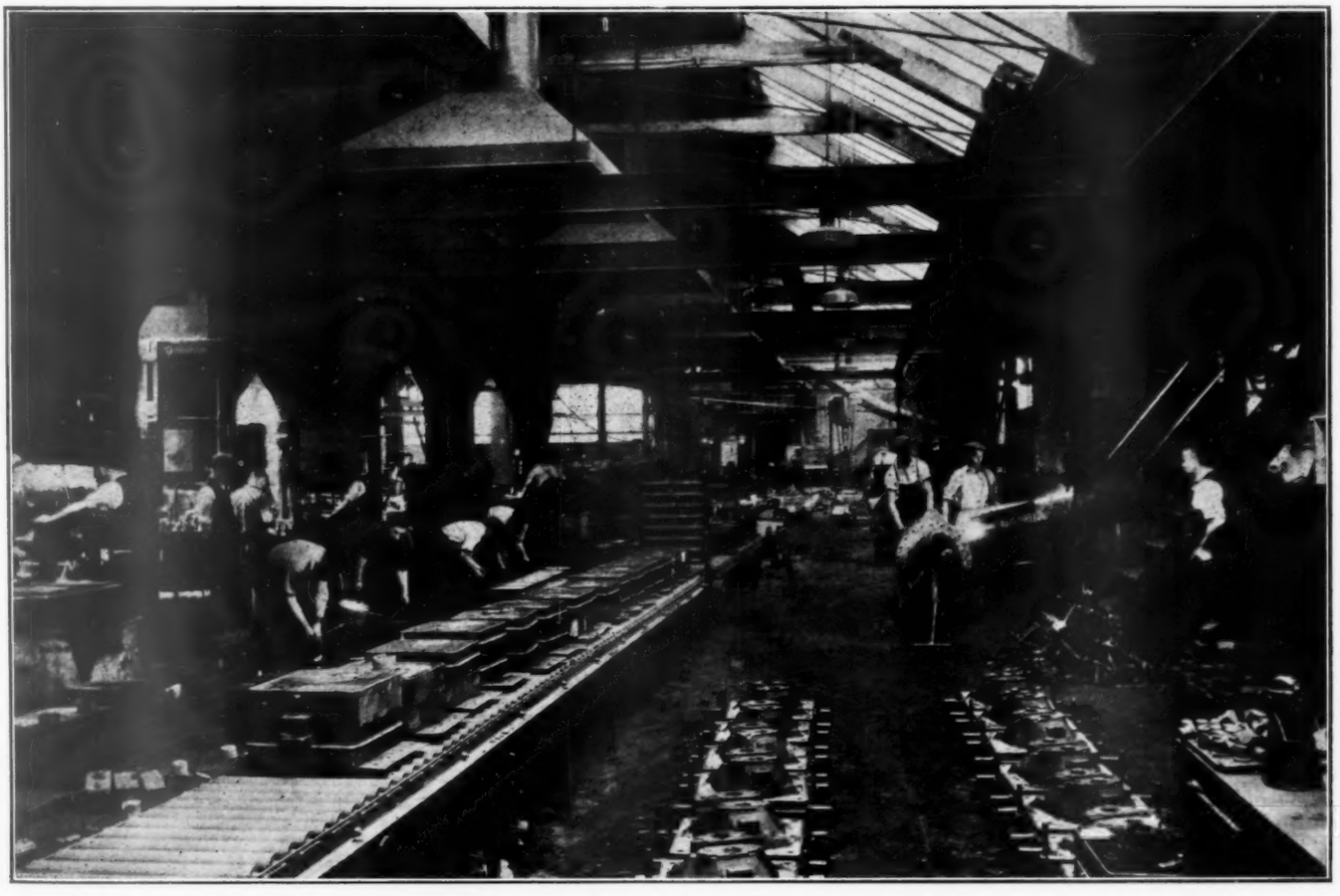

Fig. 6.—General View of the Plant, which includes the Cupola Plant, Mixing Ladle and Mould Conveyor.

gas entirely free from dust, which CO_2 is obtained from a small hot-air producer (see Fig. 11) with double combustion of special and novel construction. The producer is fixed close to the ovens, but outside the coreshop under a lean-to roof, for convenience in connection with the fuel supply and to eliminate fire risks. Fig. 11A shows its detailed construction.

By means of a regulatable deflecting plate in the trough more or less hot air can be distributed into any portion of the oven, according to the size and weight of the cores charged.

The hot-oil vapour, given off by the cores in process of being dried, and waste heat are exhausted evenly from the top of each oven by an independent small chimney in which a butterfly valve has been fixed for control. All the controls, both for the inlet of hot air into the troughs and the outlet of waste heat, are within easy reach of the operator, and an automatic cut-out controls the exhaust valves, by the opening of the doors, and thus prevents any wastage of heat during their frequent opening for charge and discharge of cores.

The hot-air producer is charged with cupola-quality coke two to three times a day, and is banked with lower-grade coke under natural draft during the night, so that in 10 to 15 minutes after starting up in the morning, by switching on the small pressure fan which supplies the air to the producer, the full volume of high-temperature hot air is available. A constant temperature of from 450 to 500 deg. Fah. is maintained throughout the day in the various ovens.

The coke consumption of the producer is only about two cwts. of coke per working day of 8½ hours for maintaining the necessary heat in the ovens, which consumption represents an economy of not less than 75 per cent. on the old ovens previously installed, the throughput of cores in the new ovens being considerably in excess of that previously obtained.

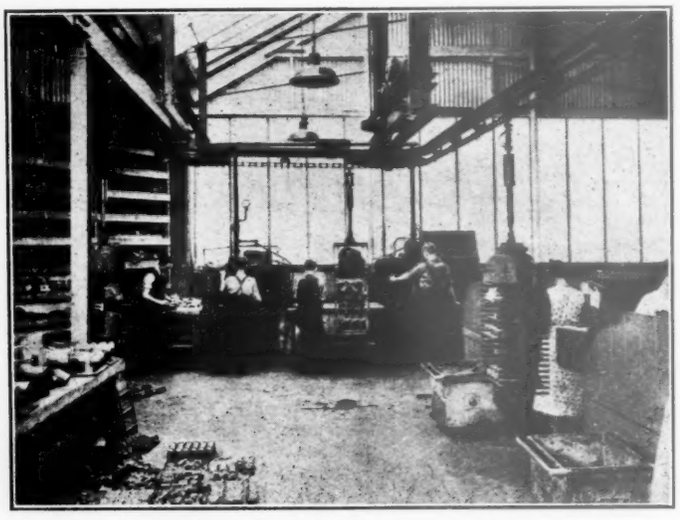

FIG. 7.—THE CORE-BLOWING PLANT IS SERVED BY A PENDULUM CONVEYOR.

FIG. 8.—GENERAL VIEW OF THE CORESHOP, SHOWING PORTABLE SAND BINS AND CONVEYOR.

The CO gas is generated in the producer, and is subsequently converted into CO_2 gas in a secondary combustion chamber integral with the producer, by the introduction of air supplied under a pressure of 25-in. w.g. by a small-pressure fan, driven by a 1½-h.p. motor. The resultant non-combustible hot air is then passed from the bottom of the producer into an insulated rectangular duct, which is situated on the floor level under the ovens. In this duct there is a controlled outlet under the bottom of each oven, which regulates the volume of hot air which it is desired to introduce into the oven.

At the bottom of each oven is a hot-air trough which distributes the air into each oven through three perforated grid plates, which form the floors of the ovens and which can be easily removed for cleaning out sand or broken cores which may fall through into the troughs.

An additional advantage is that the space now occupied by the new ovens is less than half of that previously occupied, and this has enabled additional core-storage racks to be built on the released space.

It is also of passing interest to note that a firewood-drying oven of similar design, placed outside the coreshop, is also supplied with hot air from the producer by a by-pass from the main hot-air duct. This oven dries the wood for starting up the brass-melting and other foundry furnaces.

The hot-air gas producer, the main duct, and the hot-air troughs below the ovens are all very completely insulated so as to eliminate any loss of heat by radiation.

There is little or no dust carried into the hot-air ducts or ovens from the producer.

The whole of the operation of working the

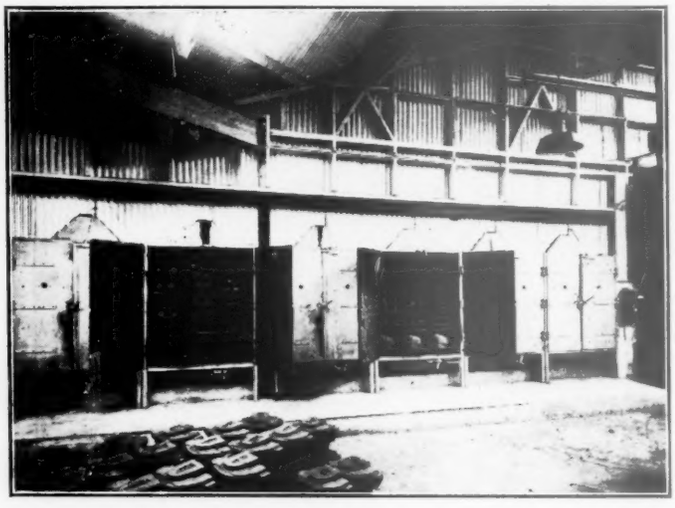

FIG. 9.—THE CORE OVENS ARE HEATED FROM AN EXTERNAL HOT-AIR PRODUCER.

FIG. 10.—SHOWING THE RELATION OF THE OVENS TO THE GENERAL LAY-OUT OF THE SHOP.

producer, regulating the hot-air supply, and exhaust, charging and discharging the cores into and from the ovens is done by one operator.

This new plant was designed and manufactured in conjunction with the firm's foundry consultant, John A. Smeeton, M.I.Mech.E., of 17, Victoria Street, London, S.W.1, to suit the special requirements of existing conditions prevailing in the works.

Most of the cores go into temporary storage, but those destined for immediate use are loaded on to the conveyor, a section of which enters foundry proper. A two days' stock of cores is always maintained.

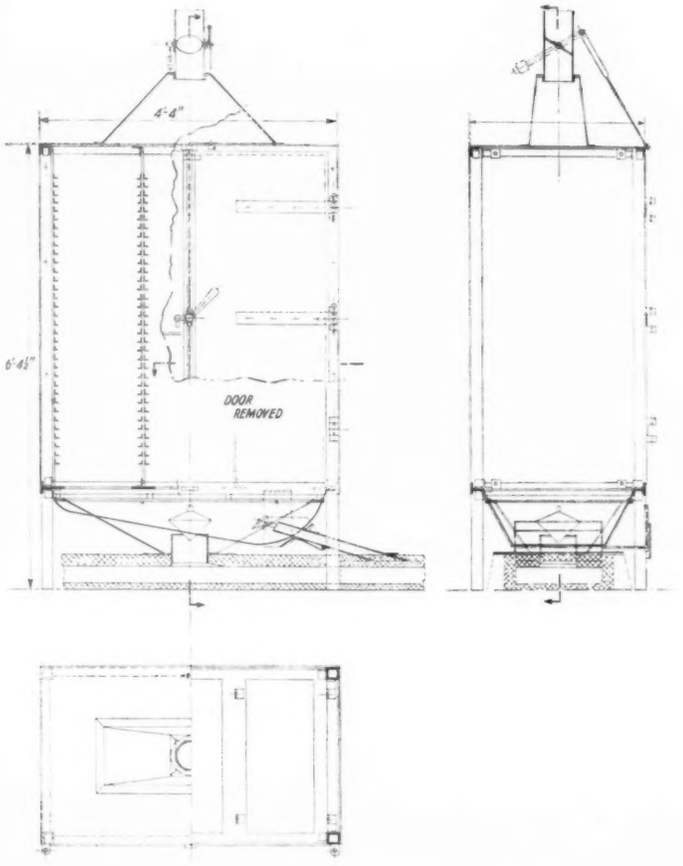

Fig. 10A.—Details of the Flue Arrangements of the Drying Ovens.

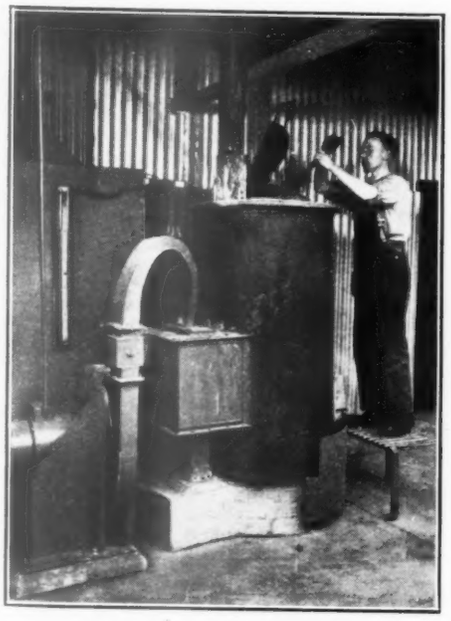

Fig. 11.—The Hot-Air Stove.

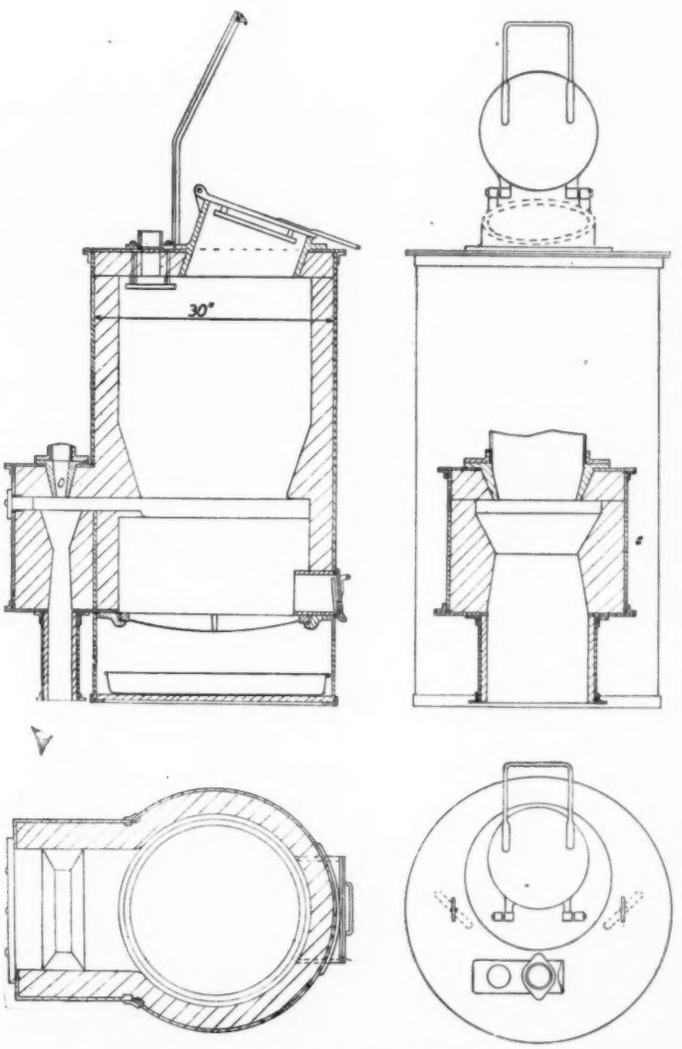

Fig. 11A.—Details of the Hot-Air Stove.

Returning again to the knock-out, the castings, after the runners and risers have been knocked off, are loaded into a cylindrical container suspended from a monorail, and by means of a drop-bottom arrangement, the containers discharge the castings alongside the rumblers, the position of which is shown in Fig. 1. The runners and risers are placed in similar containers, and are returned to the cupola-platform lift by monorail. There are three tumbling barrels, about 4 ft. long by 3 ft. dia., which are totally enclosed and are definitely dustproof. After rumbling, the castings are loaded into steel boxes carried on a length of roller conveyor, which feeds the grinding plant, consisting of eight double-ended machines, by various makers (see Fig. 12). All castings are passed through either a sand-blast tumbling barrel or two cabinet plants, all of which are attached to a "Spenstead" dust extractor. A similar plant is also used for brass and gun-metal castings, which are also made in very considerable quantities. At the end of the fettling department is the inspection bench, complete with numerous gauges, and near by is a lift used for the distribution of the castings (both iron and non-ferrous) to the stores, and subsequently machine shops or despatch department if sold in their casting form.

Brass Foundry

Melting Plant.—There are a number of forced-draft coke-fired tilting crucible furnaces, each of 420 lbs. gun-metal capacity, and a range of patent pit firs which take 180-lb. pots. The draft obtainable in the pit furnaces, although natural only, is of exceptional strength and rapid and economical melting results. This department has reduced and standardised its mixtures to very reasonable proportions and they now include two gun-metal compositions, a yellow brass, nickel and nickel bronze, manganese bronze and a proprietary alloy called "Aterite." In addition this department produces castings known as "Ni-Resist" metal.

Moulding Plant

This plant consists of about fifteen hand-operated squeeze turnover machines and the standardisation of moulding boxes mentioned earlier extends to this department. Ninety-five per cent. of the production of the foundry is carried out in four sizes of boxes, whether they be in "Sterling" steel or cast-iron, the dimensions of which are detailed in Table I.

Table I.—*Range of Boxes Used.*

Dimensions in ins.	Used for.
20 × 20	Iron.
14 × 16	Iron and brass.
12 × 12	Brass.
10 × 10	Iron and brass.

The backing sand is prepared by "Royer" sand throwers of the combing type and the

facing sand by a "Rotoil" machine. Whilst the non-ferrous castings are still hot, they are dipped into a tank of water and the sudden generation of steam and resulting explosion effectually removes the cores. There are eight grinders for removing flashes and the like and all non-ferrous castings pass through a sand-blast tumbling barrel plant.

Metal Recovery

A well-organised metal recovery department is maintained and the ashes are crushed, washed and the resulting metal treated by an electro-magnetic process while all scrap is meticulously sorted and graded prior to being sent to the foundry. Swarf from the machine shop is cleaned and passed over double magnets before going into stock.

Welfare

Few foundries do more for the welfare of their employees than Newman Hender; the works possesses a well-laid-out garden, with numerous benches placed in shady pathways

Fig. 12.—A portion of the Fettling Shop.

overlooking a lake; well-equipped men's and girls' canteens; a first-aid room; excellent sports grounds for cricket, hockey and tennis, etc. The whole works, which employs well over five hundred operatives, is maintained in a spick-and-span condition, so that the shops are invariably well lit and essentially well ordered.

Conclusions

This works enters a class of industrial establishments which can be characterised as following a set plan of evolutionary progress. Their first attempt at improving the foundry output was by installing hoppers above the moulding machines and filling them by a stream of sand through a shute by means of a sand-throwing machine. Now the plant has been mechanised to a far greater extent, as described above.

Finally, we wish to accord our very sincere thanks to the chairman of the company, Mr. C. P. Newman, and his son, Mr. Noel Newman, for the many courtesies extended to the writer and for the considerable help given in the preparation of this article.

Cupola Melting Rate

"S. S.," whose letter on "Cupola Melting Rate" was published in our correspondence column last week, informs us that inadvertently he made a slip in the third paragraph of his letter, the concluding sentence of which should have read "Mr. S. E. Dawson's figures for these conditions would be one-half and *one*-fifth respectively," not two-fifths as stated.

Refractories for Foundry Use

At a meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, held at the James Watt Memorial Institute, Birmingham, recently, Mr. W. J. Rees, M.Sc., of Sheffield University, spoke on "Refractories for Foundry Use." Mr. G. M. Callaghan, Branch-President, was in the chair.

Following the Paper,* which has already been published, Dr. Skerl proposed a vote of thanks to the lecturer, remarking that the work carried out on refractories by Mr. Rees was of international repute. He asked the lecturer if he thought it advisable to place an upper limit on the alumina content of firebricks. Referring to the lecturer's observations concerning the high expansion of firebricks, 92 per cent. silica, causing spalling, he wondered if the same remarks applied to rammed linings. It was interesting to note that, whereas usually the foundryman got all the blame for bad lining performance—the bricks were always considered satisfactory—Mr. Rees had shown that there were limitations to the performance of cupola bricks.

The vote of thanks was seconded by Mr. J. G. S. Primrose, who commented on the improvement in bricks induced by surface glazing. He inquired if Mr. Rees had had any experience in the use of a pinch of salt to produce artificial glazing.

Artificial Glazing

The vote of thanks was heartily accorded, and Mr. Rees, replying to Dr. Skerl, agreed that an upper limit should be placed on the alumina content of firebricks, as bricks with Al_2O_3 of 50 per cent. offered a reduced resistance to high iron slags, and he suggested an upper limit of 43 to 44 per cent. Al_2O_3. With regard to the second question, he suggested that the high expansion of the silica in the ramming material might be a positive advantage, as it would tend to neutralise the natural contraction of the bonding material of the lining. In reply to Mr. Primrose, Mr. Rees said that the pit furnace linings were a particularly good example where the glazed surface of the bricks was an advantage. He had painted the surface of bricks with an emulsion of felspar and salt in china clay, and also with a fused bauxite or ground carborundum, with good results. Such methods, however, were to be used with discretion, and were most advantageous in high-temperature muffle furnaces where temperature was the main consideration.

In reply to a member who asked what was the best type of ganister for use in a rotary furnace, Mr. Rees said there were several important factors to be considered in the patching of rotary-furnace linings. The grading of the material was important. Coarse grading tended to give high porosity in the lining and hence a danger of slag absorption and eventual crumbling of the lining. In his experiments he found that the best grading was 45 per cent. very fine material, 10 per cent. intermediate size and 45 per cent. coarse, as then close packing, good vitrification and high strength were obtained. The method of ramming was also important. If a flat tool were used for ramming there was a grave possibility of ramming the lining down in dense layers, and on heating the lining would tend to flake off. The best method was to peg-ram and so ram one layer into another and give good adhesion to the patching. Mr. Rees thought a ganister patching of 92 to 93 per cent. silica was the best, as it gave very little expansion on heating, owing to the neutralising action of its constituents.

Mr. E. Hunter said he had lined his cupola with Sheffield ganister and found that during the first melt the lining was attacked severely, but with succeeding melts the resistance of the lining was very satisfactory. He also found that the ganister lining scaled rather than cracked.

In reply, Mr. Rees said this was quite a common occurrence and was due to the recrystallisation within the lining, whereby the substance mullite was formed, giving increased strength and corrosion resistance. When protected by a fresh layer of ganister the lining absorbed some of the ganister and was slightly fluxed at high temperature. This action accelerated the precipitation of the mullite and accounted for the better performance after the first melt. With regard to the scaling of the lining, he thought this was due to the bad grading of the patching material and also to irregular heating of the lining. Coarse-graded linings would give large expansion. It was advisable to give venting in the lining to allow water to come off. Otherwise the lining might burst.

Slag Holes

Mr. W. H. Bamford asked if the lecturer could recommend any good refractory for making the slag holes, as he had experienced considerable trouble with rapid enlarging of the hole during melting. He also wished to know the nature of a frothy slag which he had noticed in a small steel-melting furnace lined with Sillimanite.

Mr. Rees said he had tried a large number of refractories for making slag holes. He had even tried chromite, but with very little beneficial result. In his opinion there was nothing better than a high-grade fireclay, high in silica. He had had no experience of the slag referred to, but thought it likely that it was a refractory slag which had absorbed Al_2O_3 from the lining.

Mr. Greenhouse asked if quenching of the bottom, after the drop out at the end of the day's blow, was bad. Did the rising steam have any harmful effect on the lining?

Mr. Rees said that quenching of the bottom was at all times bad practice. The steam caused incipient cracks in the lining.

The Chairman inquired if there was any benefit to be gained by grouting the lining of a cupola.

Mr. Rees, in reply to the Chairman, said that the successful insulating of a cupola lining was a thing to be sought, as it reduced loss of heat in the cupola and so made melting more economical. It also gave a more uniform temperature gradient across the wall, with less risk of cracking. In conclusion, Mr. Rees said that brick linings should be used with discretion, as a costly brick was not always economical unless it gave twice the life of the cheaper type.

* Foundry Trade Journal, July 18, 1935, p. 47.

Notes on Roll Failures with Reference to Chilled Iron Cast Rolls Containing Chromium and Molybdenum*

By J. SELWYN CASWELL, M.Sc., A.M.I.Mech.E.†

Some manufacturers and users of rolls have had unhappy experiences with chromium-molybdenum rolls for rolling sheets and tinplates. The purpose of this Paper is to present particulars relating to some remarkable fractures of alloy rolls and to discuss the probable causes which brought about the fracture of the rolls. The particulars of two service fractures are given below and photographs of the fractures are shown in Figs. 1 and 2.

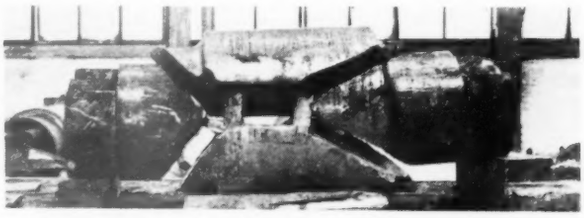

Fig. 1.—Roll A.

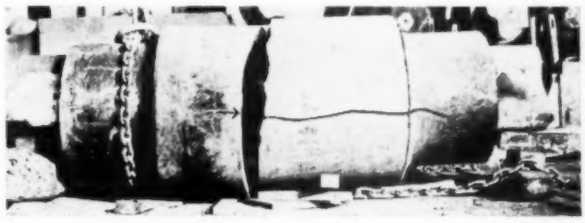

Fig. 2.—Roll B.

Roll A.—Tinplate roll, 28 in. dia. by 32 in. long: necks, 22 in. dia. Percentage analysis:—T.C., 3.14; Si, 0.70; Mn, 0.40; S, 0.104; P, 0.49; Cr, 0.69 per cent.; and Mo, trace.

This roll was broken within an hour after it had been put into service as a bottom roll. The fractured roll is shown in Fig. 1. Together with the accompanying unbroken top roll, also an alloy roll, it was returned to the foundry.

Roll B.—Tinplate roll, 27¾ in. dia. by 36 in. long; necks, 22 in. dia. Percentage analysis:—

	Turnings from top neck, as cast.	*Turnings from bottom neck, as cast.*
T.C.	3.10	3.10
Si	0.64	0.70
Mn	0.25	0.31
S	0.092	0.107
P	0.324	0.480
Cr	0.69	0.96
Mo	0.20	0.34

This roll was broken within an hour after preheating by an oil flame had commenced, and before the roll had entered upon any rolling service. This roll fracture is shown in Fig. 2. The roll and its accompanying chromium-molybdenum top roll were returned to the foundry.

The fracture of roll B is interesting because it cannot be attributed to any mechanical loading. The roll had not given any rolling service, and it had never been previously preheated. It appears clear, therefore, that it was broken by the severe thermal stresses produced during preheating with an oil flame. This does not imply that the system of heating may be defective, but rather that the rate of applying the heat was too great.

Tests Carried Out on Unbroken Rolls

The manufacturers of the rolls invited the author to investigate the effect of slow and rapid heating of alloy rolls and he was given liberty to make use of the sound alloy rolls which had been returned with the broken rolls. These rolls were now looked upon as scrap rolls, and any damage to them during the investigations was of little moment. Three rolls were available, and these were carefully examined to discover any incipient fractures. No defects were found, and two of the rolls were placed on a bogey and then charged into a cold foundry drying oven. The oven was slowly heated up to a temperature equal to that obtained under normal conditions in a tinplate mill, namely, a mean temperature of 420 deg. C. This temperature was obtained at a point 2 ft. from the centre of the oven door. When the temperature was reached, the bogey was quickly withdrawn from the oven, the third roll was placed upon it, and the bogey again rapidly returned to the oven. It was realised that the most severe stresses in the third roll would be set up very soon after the return of the bogey to the oven, and suitable precautions were taken to guard against any damage which such a proceeding might produce.

After the oven doors were closed, the temperature was again noted, and the reading was now 325 deg. C. A dull report was heard later, and it was thought that this might have been due to the slipping of one of the rolls. Half an hour later the bogey was withdrawn, but there was nothing to suggest that the rolls had slipped or suffered any damage. The rolls were taken to the roll turning shop, cleaned, and carefully examined. No defects were found on the rolls which had been placed in the cold ovens, but the examination of the third roll revealed two similar longitudinal cracks, one on each side of the barrel, almost opposite to each other and extending into the neck radius at each end of the barrel. Photographs of the cracks are shown in Figs. 4 and 5. It was concluded, and with good reason it seems, that these fractures had been produced in the oven, and that the dull report was associated with their occurrence.

Both of the fractured rolls had been allowed to remain in the moulds 48 hrs. before stripping, during manufacture.

The striking feature about the fractures is that they are totally unlike the fractures which occur in "straight" carbon rolls. This is made clear by comparing them with the fractures shown in Fig. 3, which summarises a comprehensive analysis carried out by the author some time ago with the co-operation of the Welsh Plate and Sheet Manufacturers' Association.[1] The fractures of the chromium-molybdenum rolls are compound fractures and close examination reveals fine cracks which have not produced complete separation of the metal.

In the case of roll A, the initial fracture gave only two separate pieces, namely the right-hand neck (the top neck as cast), and the remainder of the roll, which contained incomplete fractures running along the mid-plane of the roll and branching toward the radius of the bottom neck as cast, *i.e.*, the left neck in the photograph. The pieces were returned to the foundry and the larger piece was severed as shown.

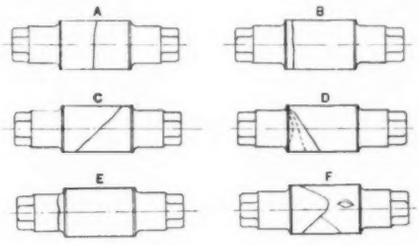

Fig. 3.—Classification of 186 Roll Breakages.

Type A Transverse, mid-body—161 = 87 per cent.
Type B Transverse, end of body—3 = 1.6 per cent.
Type C Scarf in body—16 = 8.2 per cent.
Type D Neck to body scarf—included under C.
Type E Transverse, neck or wobbler—3 = 1.6 per cent.
Type F Cracked body and spalls—3 = 1.6 per cent.

All rolls broken were "straight" carbon chilled rolls. They ranged in diameter from 22 ins. to 28 ins., and were used for hot rolling in sheet and tinplate mills.

Fig. 4.—View at one side of Crack produced in a Chromium-Molybdenum Roll.

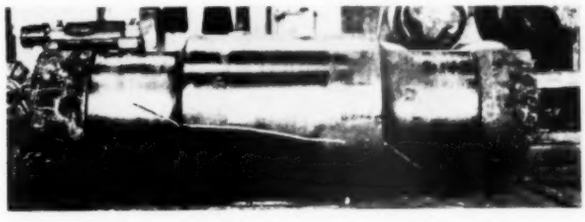

Fig. 5.—View of the Crack in the Same Roll, as seen from the Opposite Side.

* A communication published by the Institute of Mechanical Engineers.

† Lecturer in Engineering, University College, Swansea.

1 "Proc. South Wales Inst. Eng.," 1930-1, Vol. 46, p. 311.

This roll was then placed under the ball and broken by allowing the ball to fall on a point lying in one of the cracks. One blow was sufficient to fracture the roll completely, and Fig. 6 shows part of the fractured roll. An interesting point to notice in Figs. 4 and 5 is that the fracture, after running along the mid-plane of

FIG. 6.—VIEW OF THE FRACTURE OF THE CHROMIUM-MOLYBDENUM ROLL SHOWN IN FIG. 4.

the body, turns towards the radius of the neck at each end, as in the case of the roll shown in Fig. 1.

Probable Causes of Fracture

In discussing the probable causes of fracture, the following points will be considered in order:—(1) The quality and structure of the iron; (2) the design of the rolls, and (3) the stresses produced by the heating of the rolls and by the rolling loads. (This applies to roll A only.)

Quality and Structure of the Iron

Two samples of the iron were taken from roll A, one from the chill and another from a point lying in the axis of the roll and near the bottom neck. These were sent to the British Cast Iron Research Association, and the author is indebted to the Director, Mr. J. G. Pearce, M.Sc., for the following report of the examination of these samples:—

Percentage analysis.

	Edge.	Centre.
T.C.	2.95	2.98
Si	0.78	0.73
Mn	0.33	0.31
S	0.102	0.079
P	0.455	0.454
Cr	0.53	0.53
Mo	0.01	0.01

Photomicrograph, Fig. 7, was taken as near as is was possible with the sample received to the chilled face of the roll at 200 diameters. The structure is quite usual and shows cementite in a background of decomposed austenite (pearlite) and coalesced austenite from the eutectic. The presence of a number of small graphite specks was a rather unusual feature, as graphite is not usually found in more than an occasional trace at the chilled face of roll. The graphite specks are extremely difficult to observe in the photomicrograph; in most cases they are hidden by the darkness of the surrounding pearlite.

The presence of manganese sulphide and phosphide eutectic will be noticed, but it is not thought that these constituents are present in sufficient quantity to be harmful.

Photomicrograph, Fig. 8, shows the unetched structure of the grey section from the centre of the roll. It will be noticed that only a small amount of graphite is present. An unusual feature of this metal is the stringy formation of the manganese sulphide, which is more usually found in the form of angular crystals. Another feature is the presence of numerous small, and a few larger, cavities, which are to be seen in the photograph.

Photomicrograph, Fig. 9, shows an area from Fig. 8 etched in picric acid and photographed at a magnification of 200 diameters. It will be seen that the cavities are associated with the free cementite which is present throughout the specimen in large areas. Graphite in a matrix of pearlite and small areas of phosphide eutectic are also present.

Photographs designed to show these small defects are not necessarily typical of the structure as a whole, and are, in our opinion, very unlikely to have any casual relationship with the premature fracture.

Design of the Rolls

The proportions of the rolls were similar to those common to sheet and tinplate rolls, but some of the rolls were cast with wobblers of special design. The outside diameter of the wobbler was larger than the neck diameter of the roll, and the projecting horns extended over one-quarter of the neck periphery on opposite sides.

The author considers that the design is defective, because the projecting horns interfere with the free contraction of the roll after casting. It seems reasonable to conclude that this interference would produce some symmetrical difference in the quality of the iron near the necks, and is also related in some definite way with the position of the horns. Fig. 10 illustrates this point. The contraction of the roll as it cooled would produce a pull on the sand shoulders A and B at the top and C and D at the bottom, assuming that the roll is carried either by the base EF or by the sand GH forming the radius of the bottom neck, or by both. The prevention of the free contraction of the roll after casting would probably set up planes of weakness extending from the necks to the body, and these would be symmetrically located in the roll. Consolidation of the metal in the affected zones could not proceed undisturbed, and the iron would not be in as good physical condition as that in parts where the solidification had proceeded undisturbed. Failure of the roll would be liable to proceed along these planes of weakness, and examination of the fractures of the rolls shown in Figs. 1, 4 and 5 shows that

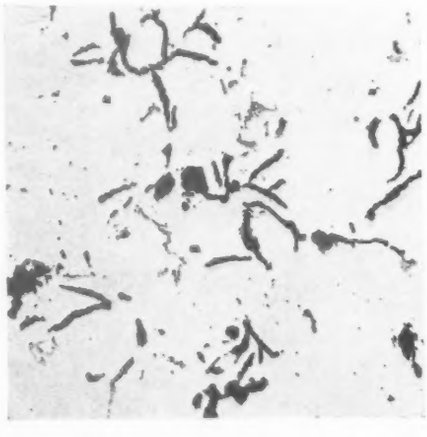

FIG. 8.—STRUCTURE OF ROLL A NEAR THE AXIS OF THE ROLL. UNETCHED. × 50.

the oblique fractures near the necks are in approximately the same position in relation to the wobblers.

There is, however, an alternative explanation due to Prof. Bacon for the unusual form of the fractures. It is suggested that fractures of this type are a peculiarity of very brittle materials, and there is no doubt that the rolls in question were brittle.

Stresses Produced by the Heating of the Rolls and by the Rolling Loads

It has been pointed out earlier that roll A was broken an hour after it had been put into service, and that roll B was broken before it had been subjected to any rolling loads.

An examination of the rolling conditions which preceded the fracture of roll A indicated that the rolling loads had not been other than

FIG. 7.—STRUCTURE OF ROLL A NEAR THE CHILL FACE. ETCHED WITH PICRIC ACID. × 200.

normal. Measurements taken on the piece which was passing between the rolls when the roll was broken showed that the draft on it was $\frac{3}{32}$ in.; this is a normal draft for the pass that was being rolled. The width of the piece was $20\frac{3}{4}$ in., and the author was assured that the temperature of the piece was normal. The piece had proceeded between the rolls for a distance of 30 in. before the fracture occurred, and it is significant that the fracture occurred when the suggested planes of weakness in the casting were in the most unfavourable position for carrying the load, *i.e.*, with the crests of the inclined planes of weakness in a horizontal plane.

There was less freedom of movement for the wobblers in this position, and the fracture appears to be the result of the combined effect of (1) low strength of the iron, (2) defective wobbler design, (3) the rolling load stresses, and (4) excessive thermal stress. In respect of the last factor, it is important to note that the roll was broken on a Monday morning and at the beginning of the first shift of the week. At this time of the week the face temperature of the roll is always higher than the temperature of the interior of the roll, and this applies also when the rolls have been previously preheated, because preheating, in general, does not produce temperatures as high as those prevailing later in the week.

The circumstances surrounding the fracture of roll B make it perfectly clear that the roll was broken while the face temperature was rising and whilst the flow of heat was wholly towards the axis of the roll. The thermal conditions present would produce tensile radial stresses and longitudinal tensile stresses in the core of the roll, and circumferential and longitudinal compressive stresses in the chill zone of the roll. The magnitude of these stresses would be determined by the rate of change of the temperature gradient. If the rate of change is large, the roll may be fractured internally, either along a horizontal plane or along a transverse plane. The strain energy stored in the roll and the brittle nature of the iron would promote almost instantaneous extension of the fracture to the outside of the roll. It is not improbable that simultaneous fracture along a transverse plane and a longitudinal plane would take place, and the fracture of roll B shown in

Fig. 2 strongly supports this view. It is perhaps reasonable to conclude, therefore, that the fracture of this roll was the result of the combined effect of (1) low strength iron, and (2) intense thermal stress, produced by too rapid heating with an oil flame.

General Comments and Conclusions

It has been suggested that the iron in the rolls just referred to was low in strength and that the

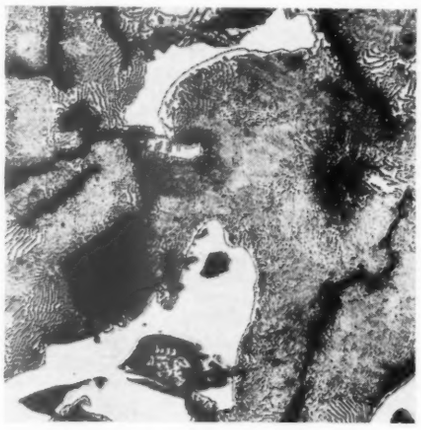

FIG. 9.—SAME AREA AS IN FIG. 8. ETCHED WITH PICRIC ACID. × 200.

wobbler design and incorrect thermal treatment were the main contributory causes of the fracture of these rolls. The attempt to obtain the benefits associated with the addition of chromium and molybdenum had been a disastrous failure.

The main influence of molybdenum is to produce a fine dispersal of the graphite, and, consequently, it is improbable that the amount of molybdenum in the rolls was a contributory factor in producing the fractures. The effect of chromium is to promote retention of the carbon in the combined form, and if the melting and casting practice had been fairly satisfactory. there may be good reason to suspect that the excess of chromium was a large contributory

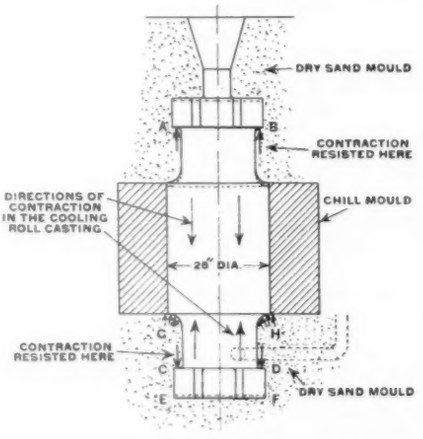

FIG. 10.—DIAGRAM SHOWING THE INTERFERENCE OF THE WOBBLER SHOULDER IN THE CONTRACTION OF THE CAST ROLL.

factor in producing the failure of the rolls. Cementite has a low tensile strength—about 2 tons per sq. in., according to Moldenke[2]—and any wide distribution of this material in the free form would have a serious weakening effect on the strength of the roll iron.

The analysis of roll A shows that there was little or no molybdenum present and that the amount of chromium was 0.69 per cent. In the case of roll B, the amount of molybdenum was between 0.20 and 0.34 per cent., and of chromium, between 0.69 and 0.96 per cent. The nature of the fractures suggests that the amount of chromium was too large, and comparison with the analysis of a chromium-molybdenum roll which gave very good service helps to confirm this view. The analysis of this roll was as follows:—T.C., 2.95; Si, 0.76; Mn, 0.27; S, 0.12; P, 0.52; Cr, 0.33; and Mo, 0.24 per cent. The amount of chromium present is much less than that in the broken rolls, and although there may be other factors to account for the good service of the roll, there is strong reason for believing that the smaller amount of chromium had an important effect in prolonging the life of the roll. It appears reasonable to conclude that 0.4 per cent. represents the safe limit for the amount of chromium in sheet and tinplate rolls. But in this matter, the effects of good and bad foundry practice must not be overlooked.

The chromium-molybdenum roll is more expensive than the straight carbon roll, and the additional cost may not always be justified. In many cases of breakage, the fault lies with those who have carelessly used the rolls, and in other cases the foundrymen are at fault. Straight carbon rolls, properly used, may give long and high-quality service. Particulars are given in Table I of an ordinary sheet-mill roll which gave

TABLE I.—*Percentage Analysis of a Sheet Mill Roll.*

Dimensions: 30 in. dia. × 39 ins. long; necks, 24 ins. dia. The roll was used in the Staffordshire system of rolling. Life: five and a-half months as a hot finishing roll, and over nine months as a "soft" roll.

Location of the material analysed.	C.C	G.C.	Si	Mn	S	P
At a point near to the chill face ..	1.00	1.68	0.75	0.38	0.140	0.56
At a point midway between the face and the roll axis ..	1.10	1.53	1.02	0.40	0.148	0.56
At a point on the roll axis ..	1.10	1.37	0.82	0.40	0.142	0.44

five and a-half months' service as a hot roll and over nine months as a "soft" or roughing roll. Fracture of the roll occurred after this length of service, and in view of the good results obtained, a fairly comprehensive analysis of the roll iron was carried out. Analyses were made on iron taken from a point near the chill face, a point midway between the face of the roll and the roll axis, and from a point near the roll axis.

In conclusion, the author desires to thank Prof. Frederic Bacon, M.A., M.I.Mech.E., head of the engineering department, University College, Swansea, the roll manufacturers and the roll users, who very kindly gave free facilities for conducting the inquiry, and Mr. J. G. Pearce, M.Sc., Director of the British Cast Iron Research Association, for the report, analysis, and photomicrographs relating to one of the rolls.

2 "The Principles of Iron Founding" (McGraw-Hill), p. 41.

MESSRS. CRAVEN BROS. (MANCHESTER), LIMITED, have appointed Mr. J. Cullimore, M.A., A.M.I.C.E., as manager of their new London office at 3, Victoria Street, Westminster, S.W.1. As and from January 1, 1936, Messrs. J. B. Corrie & Company, Limited, of 15, Victoria Street, Westminster, London, S.W.1, who have for many years represented Craven Bros. in London and the Home Counties, and in London for certain overseas business, will cease to represent them, and in future these interests will be taken care of by their own organisation in London. The severance of Craven Bros.' long connection with Messrs. J. B. Corrie & Company, Limited, has been made with regret, but their rapidly-expanding interests, both in this country and overseas, have made it necessary for them to have their own organisation in London.

American Society for Testing Materials

CURRENT WORK IN FERROUS METALS

Committee A-3 on Cast Iron of the American Society for Testing Materials is working on a revision of the present pig-iron specification and has under consideration a revised specification for cast-iron car wheels. A new specification for light grey-iron castings is nearing completion. Sub-Committee XIV on Correlation of Test-Bar and Casting is making a study of the current specifications in order to harmonise the values given in these specifications for test results. The work on impact testing is continuing for the present. This comprises the development of a suitable testing machine for the repeated drop test.

The question of the effect of temperature on the rate of corrosion in the salt-spray test has been under consideration by Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys and further studies of this phase of the accelerated test will be made. The 1935 report of the committee includes test data on 24 different metals in rural, sea coast and industrial atmosphere extending over a period of three years at eight test locations, and in addition, results of tests carried on in sea water, sodium hydroxide and sulphuric acid. One of the most interesting committee projects deals with a study of galvanic and electrolytic corrosion carried on by exposing different couple combinations to the atmosphere of the various test locations. This work has now made it apparent that the table of "Electrolytic Single-Potential Differences" does not necessarily predict which metal of a couple will corrode nor the extent of that corrosion. The tests in the atmosphere, in liquids and with the couple combinations will be continued.

Committee B-5 on Copper and Copper Alloys, Cast and Wrought, has completed an active year and is planning to prepare specifications for wrought phosphor bronzes and also standards covering wrought low brass and commercial bronze strip. Certain of the newer condenser-tube alloys have been studied and specification requirements are being developed for these with the possibility that consolidation of all condenser-tube requirements into one standard may prove to be feasible. The committee also is planning to revise some of the new silicon-bronze specifications so that they may be brought more nearly in line with present commercial practice. The committee has under way a programme involving revisions of casting specifications under its jurisdiction to bring them into proper relationship with the ingot-metal specifications and to modernise them.

L.M.S. Wagon Orders

A sum of £2,232,000, it is announced by the London Midland & Scottish Railway, will be spent by the company during 1936 on new passenger and freight rolling stock. The programme includes the building of nearly 10,000 vehicles, most of which will be constructed in the L.M.S. workshops at Derby and Wolverton. The present stock of freight vehicles, on which £1,173,000 will be spent, will be augmented by 9,235 vehicles. Orders for 1,000 are to be placed with the following firms:—50 30-ton bogie bolster trucks, Hurst, Nelson & Company, Limited; 100 20-ton tube wagons, Hurst, Nelson & Company, Limited; 200 20-ton tube wagons, Charles Roberts & Company, Limited; 350 20-ton hopper wagons, Metropolitan-Cammell Carriage & Wagon Company, Limited; 200 20-ton hopper wagons, Birmingham Railway Carriage & Wagon Company, Limited; 100 20-ton hopper wagons, Gloucester Railway Carriage & Wagon Company, Limited.

XUM

Temper Brittleness in Cast Iron and the Influence of Nickel and Molybdenum

By J. E. HURST (President of the Institute of British Foundrymen)

The phenomenon of temper brittleness in steels, particularly nickel chromium alloy steels is well known, and is characterised by a pronounced decrease in impact value or toughness in specimens of heat-treated material after tempering at low temperatures, particularly in the region of 500 deg. C. The possibility of the existence of similar phenomena in alloy cast irons does not appear to have been investigated. Considerable interest, therefore, is attached to the experimental results given in this investigation, as they disclose changes in mechanical properties of certain alloy cast irons after exposure to temperature conditions of 500 deg. C. which might be regarded as analogous to the temper brittleness phenomena in steels. The experimental results were obtained in the course of an investigation into the influence of alloy additions to aluminium-chromium and plain chromium alloy cast irons of compositions within the ranges suitable for nitrogen hardening.

An alloy cast iron suitable for nitrogen hardening and containing the alloy additions aluminium and chromium has been described fully by the writer.* During the process of nitrogen hardening alloys of this type are subjected to the influence of ammonia gas for a prolonged period of 90 hrs. at a temperature of 500 deg. C. (± 5 deg. C.). In view of this prolonged low-temperature treatment, it is of some importance to study the effect of this treatment of the mechanical properties, particularly with a view to ascertaining whether such treatment is accompanied by enhanced brittleness. In the case of some alloy steels such treatments at temperatures within the neighbourhood of 500 deg. C. are known to bring about brittleness and in the case of alloy steels suitable for nitrogen hardening, this matter has been given some attention.

* "J.I.S.I.," No. 1, 1932.

In the test results given by the author* the mechanical properties were studied both in the "as cast" condition and after 90 hrs. nitrogen hardening treatment at 500 deg. C. In addition, the properties were also studied for the same specimens in the annealed and hardened and stabilised condition. From a summary of these results given in Table I it is quite clear that in the case of these specimens the properties measured are not in any way affected to their detriment and in fact the prolonged exposure to the temperature of 500 deg. C. under nitrogen hardening conditions is actually accompanied by a slight increase in the ultimate strength results.

TABLE I.—*Mechanical Properties of Aluminium-Chromium Alloy Cast Iron.*

Condition.	Treatment.	Modulus of elasticity. Lbs. per sq. in. × 10^6	Tensile strength. Tons per sq. in.	Modulus of rupture. Tons per sq. in.	Brinell.
"As cast" sand moulds		19.5	19.8	31.6	340
"As cast" centrifugal		22.2	24.5	39.2	418
Annealed sand moulds	950 deg. C. followed by slow cooling in furnace	19.7	25.8	41.3	269
Annealed centrifugal		22.5	31.5	50.4	302
Hardened and stabilised sand cast	O.Q. from 870 deg. C. reheated to 600 deg. C. for 1 hr. slow cooled	19.2	28.6	45.7	300
Nitrogen hardened (sand moulds)	90 hrs. at 510 deg. C.	23.0	29.5	47.2	302
Nitrogen hardened (centrifugal)		20.1	23.9	38.3	—
		24.8	28.9	46.3	—

The chemical composition of this alloy cast iron in the sand cast and centrifugally cast condition is given in Table II.

TABLE II.—*Chemical Composition of Aluminium-Chromium Alloy Cast Irons.*

	Sand cast.	Centrifugally cast.
T.C.	2.65	2.65
Gr.	1.63	1.10
C.C.	0.99	1.55
Si	2.44	2.58
Mn	0.60	0.61
S	0.075	0.07
P	0.098	0.096
Cr	1.58	1.69
Al	1.37	1.43
Ni	Trace	Trace
V	Trace	Trace
Ti	Nil	Nil
Mo	Nil	Nil

Influence of Nickel

Experiments were undertaken to determine the influence of nickel when added to an aluminium-chromium alloy cast iron of the same type as that referred to above. In this case, the alloy cast iron was prepared by melting refined chromium pig-iron and returned scrap in an oil-fired crucible furnace. Aluminium additions in every case were made by means of pure notched bar, added to the molten metal in the ladle just prior to pouring. In the first experiment recorded, nickel additions to the aluminium-chromium cast iron, prepared in the above manner, were made to the metal when melted in the crucible, in the form of thin gauge, pure nickel sheet. Two specimens were prepared which were found on analysis to contain 0.84 and 1.18 per cent. nickel respectively. The chemical analysis and mechanical tests in the "as cast" condition and after nitrogen hardening for 90 hrs. at 500 deg. C. are recorded in Tables III and IV.

The "as cast" annealed specimens were prepared from castings which had been subjected to an annealing treatment at 950 deg. C. followed by slow cooling in the furnace. The sizes of the test specimens and the castings in each case were as nearly identical as could be produced under ordinary conditions of casting and machining. These results show a marked lowering in the ultimate strength values after subjection to a treatment at 500 deg. C. for a period of 90 hrs. under nitrogen hardening conditions amounting to approximately 12 and 20 per cent. respectively. A repetition of these experiments on two subsequent occasions was accompanied by results of a similar character, and the aluminium chromium-nickel alloy cast iron suffered a reduction in ultimate strength properties after subjecting to the low-temperature nitrogen-hardening treatment.

A further experiment carried out on a quantity of alloy cast iron of a composition, and prepared and melted under conditions calculated to produce high strength properties, is of interest also in this connection. The final composition of the alloy castings from which the specimens were taken is as follows:—T.C. 2.87, Si 0.32, Mn 0.30, P 0.06, Cr 1.68, Al 1.69, Ni 1.95 per cent. and Mo nil.

In this case the molten metal was superheated in a coke-fired melting furnace and the nickel addition made to the molten metal in the crucible. The aluminium addition was made prior to pouring the casting. The test castings were annealed in exactly the same manner as in previous experiments recorded, and the test-pieces machined from the machined specimens yielded phenomenally high ultimate strength values as follow:—En value 23.5 lbs. per sq. in. × 10^6, and tensile strength 48.0 tons per sq. in. (ring test).

TABLE III.—*Chemical Analyses of Aluminium-Chromium-Nickel-Alloy Cast Iron Specimens.*

	No. 1.	No. 2.
T.C.	2.39	2.39
Si	2.78	2.78
Mn	0.64	0.66
S	0.074	0.070
P	0.095	0.099
Cr	1.33	1.38
Al	1.26	1.34
Ni	0.84	1.18
V	Nil	Nil
Ti	Nil	Nil
Mo	Nil	Nil

In view of this high test result obtained from the ring test it was deemed advisable to check the result on the ordinary form of straight tensile test. Accordingly a straight tensile test-piece was milled from the castings and machined to 0.3 in. dia. over a 2-in. gauge length. On testing in a Buckton testing machine, a strength of 38.3 tons per sq. in., with an elongation of 1.5 per cent. on the 2-in. gauge length was obtained. The Brinell hardness in this condition determined on a Firth hardometer with a 2-mm. ball and 30-kg. load was 320. Specimens of this material after subjecting to 90 hrs. at 500 deg. C. nitrogen-hardening treatment suffered a very marked drop in strength properties. The results obtained after this treatment were as follow:—En value, 21.9 lbs. per sq. in. × 10^6, and tensile strength, 29.0 tons per sq. in. A straight tensile test-piece of similar dimensions to the above, when tested after this treatment, gave a result of 19.7 tons per sq. in., showing a falling off of nearly 50 per cent. in strength value.

TABLE IV.—*Mechanical Properties of Aluminium-Chromium-Nickel Specimens, detailed in Table III.*

Specimen.	Modulus of elasticity. Lbs. per sq. in. × 10^6	Tensile strength. Tons per sq. in.	Modulus of rupture. Tons per sq. in.	Brinell.
No. 1. As cast and annealed	23.7	28.8	—	355
No. 1. 90 hrs. at 500 deg. C. in ammonia	22.9	24.2	—	—
No. 2. As cast and annealed	23.8	27.7	—	313
No. 2. 90 hrs. at 500 deg. C. in ammonia	23.0	21.7	—	—

Influence of Molybdenum

This marked falling off in ultimate strength properties observed in this experiment on

aluminium-chromium alloy castings containing nickel after prolonged exposure to a temperature of approximately 500 deg. C. under nitrogen-hardening conditions, reminded one of the phenomena of temper brittleness met with in alloy steels, and this at once suggested the possibility of exploring the influence of molybdenum additions.

TABLE V.—*Chemical Composition of Nickel-Chromium-Molybdenum Cast Iron.*

Specimen.	T.C. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	Cr. Per cent.	Ni. Per cent.	Mo. Per cent.
1	2.88	0.30	0.30*	0.08*	1.19	1.25	Nil
2	2.94	0.38	—	—	1.38	2.26	Nil
3	2.86	0.29	—	—	1.35	2.58	Nil
4	2.90	0.31	—	—	1.25	1.30	0.25
5	2.87	0.37	—	—	1.50	2.17	0.26
6	2.80	0.36	—	—	1.48	2.47	0.25

* Calculated.

A series of experiments was undertaken and the chemical composition of the range of specimens prepared are given in Table V. The specimens were prepared by melting in coke-fired crucible holes, the molybdenum being added in the form of the 60 per cent. ferro-alloy. A series of six specimens was obtained, three without molybdenum and three with molybdenum additions, containing varying quantities of nickel and

TABLE VI.—*Mechanical Properties of Nickel-Chrome-Molybdenum Alloys detailed in Table V.*

Specimen.	Modulus of Elasticity. Lbs. per sq. in. × 10^6		Tensile Strength. Tons per sq. in.	
	As cast annealed.	90 hrs. at 500 deg. C.	As cast annealed.	90 hrs. at 500 deg. C.
1	29.7	28.5	28.7	24.2
2	29.8	28.5	29.5	24.8
3	27.0	25.8	31.2	26.9
4	30.1	29.5	30.1	30.2
5	31.0	29.7	32.3	31.7
6	27.7	26.0	34.4	29.9

chromium, but without the addition of aluminium. The full details of the final analyses are set out in the table, and it is necessary to add that the base iron used in the preparation of all the specimens was the same. The cast specimens were annealed in exactly the same manner as recorded in the previous experiments, and the mechanical test results of the "as cast annealed" specimens and the specimens after

TABLE VII.—*Chemical Composition of Aluminium-Chromium Alloys containing Nickel and Molybdenum.*

Specimen.	T.C. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	Cr. Per cent.	Al. Per cent.	Ni. Per cent.	Mo. Per cent.
1	2.50	2.41	0.50	0.13	1.62	Nil	Nil	0.70
2	2.42	2.49	0.46	0.12	1.67	1.50	Nil	0.68
3	2.51	2.46	0.51	0.11	1.70	1.61	1.09	Nil
4	2.48	2.50	0.48	0.12	1.62	1.55	1.12	0.69

treatment for 90 hrs. at 500 deg. C. under nitrogen-hardening conditions are recorded in Table VI. A consideration of these test results is of interest. The specimens Nos. 4 and 5 containing 0.25 per cent. molybdenum show an almost negligible falling off in tensile strength, whereas the corresponding specimens Nos. 1 and 2 with molybdenum reveal a falling off in strength of a similar order to that recorded in previous experiments after the low-temperature nitrogen-hardening treatment.

Two other points of importance also emerge. Of these perhaps the most important from the point of view of the present considerations is that this reduction in strength after low-temperature treatment occurs in the molybdenum-free specimens, although the aluminium is absent also. This appears to show that the effect cannot be attributed to the aluminium. The second point is that the general level of strength is appreciably higher in the specimens containing molybdenum. This is in line with existing knowledge of the influence of molybdenum additions and is an interesting confirmation of the influence of an addition of this element, as small as 0.25 per cent. The presence of this amount of molybdenum in the specimen containing approximately 2.5 per cent. nickel does not appear to have been successful in preventing the reduction in strength after the low-temperature treatment. It is thought that the presence of a larger quantity of molybdenum may have had the desired effect.

A further experiment on the addition of molybdenum to an alloy containing aluminium can be recorded here with advantage. In this case, four specimens were made from the same base material melted in an oil-fired crucible furnace. The chemical analyses are recorded in Table VII and the mechanical tests in Table VIII. In this experiment a somewhat larger addition of molybdenum was used in the

TABLE VIII.—*Mechanical Properties of Aluminium-Chromium Alloys containing Nickel and Molybdenum.*

Specimen.	Modulus of Elasticity. Lbs. per sq. in. × 10^6		Tensile Strength. Tons per sq. in.	
	As cast annealed.	90 hrs. at 500 deg. C.	As cast annealed.	90 hrs. at 500 deg. C.
1	25.5	24.9	41.5	39.6
2	24.9	24.7	39.3	39.2
3	25.1	24.2	38.1	30.0
4	25.8	24.0	40.2	39.2

specimens containing this element, a calculated addition of 0.75 per cent. Mo being made in the form of 60 per cent. ferro-molybdenum. All the alloys were prepared from the same base of chromium alloy pig-iron. In specimen (1) additions of molybdenum alone were made and in specimen (2) a joint addition of molybdenum and aluminium. Specimen (3) contained a joint addition of aluminium and nickel, and specimen (4) a joint addition of aluminium, nickel and molybdenum. The ultimate strength results after exposure to the low-temperature treatment show a falling off only in specimen (3) containing nickel, aluminium and chromium, but no molybdenum. The specimens (1) containing molybdenum and chromium, (2) molybdenum, aluminium and chromium and (4) molybdenum, nickel, aluminium and chromium, show a negligible falling off in strength after the low-temperature treatment. These experiments appear to show clearly that molybdenum either alone or in conjunction with aluminium does not bring about any reduction in strength after low-temperature treatment under nitrogen-hardening conditions and that it is effective also in preventing the reduction in strength under these conditions when nickel is present in the alloy.

Savings Effected by use of Manganese Steel and Silicon Steel

The two inventions of Sir Robert Hadfield, Bt., F.R.S., namely manganese steel and silicon steel, are now of world-wide use, and it is estimated that these have already effected a saving to the world of some £1,000-million; manganese steel by its extraordinary and unique qualities of durability and toughness; and silicon steel by greatly reducing the waste of energy losses in electrical machinery. Both the inventions in question represented an epoch in the line of metallurgical advance, and as showing that they were of basic character it may be mentioned that their compositions remain to-day exactly as Sir Robert first conceived them so many years ago.

Copper Prospects

BY "ONLOOKER."

The past few weeks have seen a material strengthening of the position in copper, for after a somewhat hectic advance, when widely-spread speculative interests bought heavily in the expectation that the campaign in Abyssinia would prove to be the forerunner of an extended conflict, there has been a period during which these purchases have been largely liquidated by their holders. The copper thus unloaded has passed into surer keeping, and if in the process consumers have secured cover rather farther ahead than is customary with them, the position of the producers is such that there is no kind of pressure at all on the London market.

Here, perhaps, is the secret of the radical change that has come over the copper situation during the past few months, for it will be remembered that, at any rate up to the formation of the curtailment pact, and even for a time thereafter, pressure of American sales weighed heavily on the standard market in Whittington Avenue. In short, nobody to-day is a very keen seller of copper, and buyers find that do they but show even a modest determination to make purchases the price stiffens rather quickly against them. This is as it should be, for consumers will find it a wise policy to carry more metal than they have done of recent years, and, moreover, their buying policy will perforce be amended from one of short and sudden incursions to the more reasonable practice of day-to-day covering. For something like a decade copper has displayed a fluctuating price trend which has been to the detriment of all connected with the trade, and if we are now entering upon a period of comparative stability there are great hopes of bright days ahead.

Effect of Rigid Price Control

Rigid price control was attempted by Copper Exporters, Inc., in 1929, and copper is only now painfully emerging from the damage done at that time. The London Metal Exchange broke that stranglehold and the same thing would happen again were similar tactics to be attempted, but there is every indication that the producers have learnt their lesson and are not likely to attempt such a policy again. America's day of dominance in the copper situation is done, and with its passing the London market is assuming an importance it has not wielded for many years. That, however, means that rigid price control is unthinkable, for, in essence, Whittington Avenue is a free market, where *some* price variation is part and parcel of the whole scheme of things.

There are, of course, those who maintain that the system of trading on the London standard market makes speculation too easy and leads to exaggerated price fluctuations. That there is some truth in this criticism cannot be denied, but, in spite of it, the plan of an open market has stood the test of time and has survived many vicissitudes and troubles. The fact of the matter is that speculative participation in the commodity markets tends to exaggerate a price tendency, but without the assistance of external factors speculation cannot keep things going of its own accord. Merchants and manufacturers do not object to a certain amount of movement in the quotation of any commodity, but what they do dislike very much is anything in the nature of a ramp.

We have already suggested that the producers have learnt the lesson of how not to do things, and they may be relied upon to watch developments very carefully in regard to the operation of their curtailment scheme. Statistically, the copper position is improving, and the time will doubtless come when some increase in output will have to be considered. This matter will need careful handling if the market is not to be unduly scared, and complete frankness will prove to be best.

XUM

This Week's News in Brief

Trade Talk

THERE ARE 38 VESSELS, totalling 83,000 net register tons, laid up on the Tyne, compared with 72 vessels and 140,000 tons at the corresponding date last year.

THE CARDIFF OFFICE and stock depôt of Messrs. Ferodo, Limited, is being transferred as from November 18 from 39, Charles Street to 60, Charles Street, Cardiff.

A VISIT WAS MADE RECENTLY by members of Repton College Junior Science Society to the works of Messrs. Haslam Foundry & Engineering Company, Limited, Derby.

ANOTHER ORDER from Messrs. J. Hay & Sons, Limited, Glasgow, has been received by Messrs. Ailsa Shipbuilding Company, Limited, Troon, for a coasting steamer of about 1,200 tons deadweight.

THE EXPENDITURE OF £20,000 is being considered in order to improve and extend the gas plant of the Kingston and St. Andrew Corporation at Jamaica. It is understood that all the plant will be obtained from the United Kingdom.

PROF. C. H. DESCH, Superintendent of the Department of Metallurgy and Metallurgical Chemistry at the National Physical Laboratory, Teddington, gave an address at Leeds University recently on "Metals in the Chemical Industry." It was the Jubilee Memorial Lecture of the Yorkshire Section of the Society of the Chemical Industry.

THE STEEL COMPANY OF SCOTLAND, LIMITED, has carried out a reconstruction at the Hallside Works, Newton, where a new furnace has been built. Another furnace has been planned, and work will begin at an early date. The loading facilities are being improved to provide for an increased output. The firm is also planning changes at the Blochairn Ironworks, Glasgow.

THE NO. 3 BLAST FURNACE at the Corby works of Messrs. Stewarts and Lloyds, Limited, which has been under reconstruction, was put into operation recently. The lighting of the reconstructed furnace marks the completion of the first stage of Messrs. Stewarts and Lloyds' great Corby steel scheme, which has cost approximately £3,000,000. Further extensions to the plant are to be made.

MESSRS. BURNTISLAND SHIPBUILDING COMPANY, LIMITED, have received from Mr. Lawrence Glen, Glasgow, an order for two more timber- and coal-carrying steamers, each of 2,850 tons deadweight capacity. The propelling machinery, consisting of triple-expansion engines and the boilers, will be constructed and installed by Messrs. David Rowan & Company, Limited, of Glasgow.

THE ADMIRALTY have entrusted to Messrs. Scotts' Shipbuilding & Engineering Company, Limited, the construction of the machinery of a cruiser of the Southampton class of the 1935 programme, the hull of which is to be built at Devonport. The value of the order is estimated to be about half-a-million pounds. With this contract Clyde firms now have on order the machinery of five Southampton-class cruisers.

THE ALBION MOTOR COMPANY, LIMITED, Scotstoun, Glasgow, are negotiating for the acquisition of the plant of the Halley Motors, Limited, at Scotstoun. The Halley concern, which is at present owned by North British Locomotive Company, Limited, is in liquidation. No information is at present available as to the intentions of the Albion Company, with regard to the plant if the negotiations go through.

MESSRS. BARCLAY CURLE & COMPANY, LIMITED, Whiteinch, Glasgow, have booked two orders for vessels this week. The Nourse Line have ordered a cargo steamer of 7,500 tons to be fitted with reciprocating steam engines working in conjunction with a Bauer-Wach turbine installation. Messrs. Thomas Dunlop & Company, Limited, Glasgow, have ordered a motorship of 9,200 tons deadweight as a result of the Government's scheme to assist tramp shipping.

THE NETHAN IRON WORKS at North Motherwell, belonging to Messrs. Frederick Braby & Company, Limited, Glasgow, are starting again on Monday. This plant is one of two puddling works left in the Motherwell area. It is subject to intermittent operation, but recently spells of employment have become longer and have occurred at more frequent intervals. The works are put into operation whenever Messrs. Braby receive an order calling for large quantities of wrought iron.

Obituary

MR. GEORGE FULTON, J.P., who spent practically all his working life in the works of Messrs. Glenfield & Kennedy, Limited, died recently at the age of 78.

MR. JOHN MORRISON, who was well known in railway and foundry circles, died recently. He retired from railway service about 12 years ago, and entered the employ of Messrs. Jones & Campbell, Torwood Foundry, Larbert, where he remained until the time of his death.

MR. SAM BERRESFORD, a director of the Staveley Coal & Iron Company, Limited, died recently at the age of 86. Mr. Berresford, who lived at Chesterfield, started with the company in 1865, and had thus had 70 years' continuous service with the firm. He became secretary, and was appointed a director in 1921. He was also a director of the Yorkshire Main Colliery (1923), Limited. A native of Chesterfield, he was educated at Chesterfield Grammar School. His first position with the Staveley Company was as junior clerk. He afterwards became clerk at the old foundry, and in 1876 he was transferred to the general offices as assistant to the company's accountant. About 40 years ago Mr. Berresford was appointed secretary, succeeding Mr. H. Westlake, and he held that position up to a few years ago, when he was made a director. Mrs. Berresford died about 25 years ago. Their only surviving son is Mr. H. H. Berresford, who is the commercial manager of the Staveley Company.

THE LATE MR. SAM BERRESFORD.

The funeral took place at Chesterfield last Thursday. Among those present from the Staveley Company were Mr. D. N. Turner (managing director), Mr. J. Hunter (agent), Mr. T. E. Haslam (secretary of the Sheepbridge Coal & Iron Company), Messrs. C. E. Whitehead, J. Carmichael (secretary), E. P. Bastide (solicitor), T. A. McKenna (London), W. H. Skinner (London), S. Martin, H. Bower, J. W. Last, H. Bowyer, J. Allsopp, W. Ward, J. W. Harris, F. Bradbury, W. Lettall, A. G. Connell, R. Hawley, C. H. Mather, O. V. Narburn, G. A. Portman, H. Drury and J. Bradley.

WE VERY SINCERELY REGRET to announce the death of Mr. F. W. Finch, the first secretary, and for many years treasurer of the Institute of British Foundrymen, which took place on November 8 at the residence of his daughter at Stonehouse, Gloucestershire. The interment took place at Stroud on November 13. It was due to correspondence initiated in the columns of THE FOUNDRY TRADE JOURNAL by Mr. Finch that the British Foundrymen's Association, afterwards the Institute of British Foundrymen, was established in 1904. For some years he was secretary of the Institute, afterwards for a period of over 20 years he was treasurer. In 1933 his services were recognised by the award of the Meritorious Services Medal, which was made to him at the Institute's Conference at Cardiff. Mr. Finch was 89 years of age.

Personal

SIR FRANCIS JOSEPH is to join the board of directors of the Birmingham Small Arms Company, Limited.

MR. H. WINTERTON, managing director of William Cumming & Company, Limited, and Senior Vice-President of the Institute of British Foundrymen, was recently returned a member of the Milngavie Burgh Council, and was again reappointed Bailie for that burgh.

MR. A. M. MCQUISTAN, managing director of the South Durham Steel & Iron Company, Limited, returned recently from the United States, where he has been studying American methods prior to the installation by his company of new plant for the production of cold-rolled sheets.

MR. ROBERT JOHNSTONE, foreman of the instrument-making department of Messrs. Glenfield & Kennedy, Limited, Kilmarnock, was recently presented by his colleagues with a wireless set, armchair and clock, and a handbag and umbrella for Mrs. Johnstone, on the occasion of his retirement after 56 years of service with the company.

MR. A. LOGAN, who has held the position of chief chemist and metallurgist for 17 years, and foundry manager for the last two years, of Messrs. R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-upon-Tyne, has recently been appointed chief chemist and metallurgist to Messrs. The Light Production Company, Limited, of London and Slough. Mr. Logan will be largely engaged in research problems dealing with the materials and parts for internal-combustion-engine manufacture.

Contracts Open

Belfast, November 20.—200 cast-iron medium lamp columns and arms, for the Town Council. The Executive Officer, Police Committee, 5, Townhall Street, Belfast.

Ramsgate, November 18.—Cast-iron and steel main pipes and specials, for the Town Council. The Gas and Water Engineer, Gas and Water Offices, Boundary Road, Ramsgate.

Wilton, December 2.—Provision and laying of 800 yds. of 6-in. and 380 yds. of 7-in. dia. spun-iron pipes, and other work, for the Town Council. Major W. H. Bateman, consulting engineer, Batheaston, Bath. (Fee £3 3s., returnable.)

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Molybdenum & Tungsten Products, Limited.—Capital £8,000. Directors: S. Rhys, East House, Robson Road, West Worthing: T. W. G. Franklin.

Forthcoming Events

Institute of British Foundrymen

NOVEMBER 16.

Wales and Monmouth Branch:—"Patternmaking—The Craftsman and his Craft." Paper by H. Stead at the Technical College, Newport, Mon, at 6.30 p.m.

NOVEMBER 22.

Lancashire Branch (Junior Section):—"Practical Foundry Experiences." Paper by J. Sherwood at the College of Technology, Sackville Street, Manchester, at 7.30 p.m.

NOVEMBER 23.

Newcastle-upon-Tyne and District Branch:—"The Properties of Foundry Coke." Paper by W. E. Mordecai. Joint meeting with the Coke Oven Managers' Association at the Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6.15 p.m.

Scottish Branch:—"Locomotive Castings." Paper by H. Lowe at the Heriot-Watt College, Chambers Street, Edinburgh, at 4 p.m.

The Institute of Vitreous Enamellers

NOVEMBER 14.

Birmingham:—"Settling and Anti-settling Properties of Clays." Paper by F. H. Clews, M.Sc., A.I.C., at the Chamber of Commerce, New Street, Birmingham, at 7.30 p.m.

NOVEMBER 19.

London:—"Frit-Kiln Bricks." Paper by W. Hugill, M.Met., F.R.M.S., at British Industries House, Marble Arch, London, W.1, at 8 p.m.

By courtesy of the Watford Foundry Company Limited

W'BRO' RIXON'S No. 3 Foundry Iron

In the foundry illustrated above, thin-walled rain-water pipes are being produced with Rixon's W'bro' Foundry Pig Iron.

FLUIDITY

The high phosphorus content of this iron ensures the fluidity necessary to secure clean, sharply-moulded light castings. The analysis is as follows:—

	Per cent
Silicon	3.29
Sulphur	0.025
Phosphorus	1.65
Manganese	0.34
Graphitic Carbon	3.52
Combined Carbon	0.12
Total Carbon	3.64

The Stanton Ironworks Company Limited, Near Nottingham

XUM

Raw Material Markets

Conditions in the iron and steel industry are such that it is probable that the production of steel for 1935 will create a post-war record. This belief is strengthened by the increased shipping orders, the active state of the motor, engineering and building trades, the naval expansion programme, the proposals for the replacement of road bridges, and the loan for railway developments. The Tees-side makers have announced advances in the prices of Cleveland foundry pig-iron, ranging from 2s. 6d. to 2s. 9d. per ton. These alterations were expected following the recent advances made in other areas.

Pig-Iron

MIDDLESBROUGH.—The Central Pig-iron Producers' Association have announced that quotations for Cleveland foundry pig-iron are raised by 2s. 6d. to 2s. 9d. per ton. Deliveries to consumers in the Middlesbrough and North-East zones are advanced by 2s. 6d., and deliveries to Scotland are increased by 2s. 9d. This decision of the association was expected, although the increases may be rather less than had been anticipated. Producers of Cleveland iron have very little to sell at the present time, and, although ironmasters are meeting their commitments, there have been cases of having to refuse orders. Deliveries continue to be on a large scale, and there is very little iron available for export purposes. The new prices for Cleveland No. 3 G.M.B. iron delivered to home consumers are 70s. in the Middlesbrough area, 72s. on the North-East Coast, 73s. on Clydeside, and 70s. in the Falkirk zone.

The demand for hematite continues to be very satisfactory, especially from the steel-making areas, and production is being taken up very promptly. The export trade to Italy is now lost, but there have been some deliveries to the Scandinavian countries and to South Africa. The scheduled prices of No. 1 East Coast hematite are unchanged and are as follow:—Delivered Middlesbrough, 71s. per ton; delivered Tyneside, 72s.; delivered North-East Coast, 73s. 6d.; delivered Scotland, 74s.; delivered Sheffield, 78s. 6d.; delivered Midlands, 84s. 6d. per ton.

LANCASHIRE.—There has been rather less inquiry for forward buying this week. The recently advanced quotations will not have very much effect on this market for some considerable time, for consumers had been well in the market for large quantities before these prices came into operation. Deliveries have, on the whole, been well up to the average, but there has been a slight reduction in respect of the light-castings section. Machine-tool manufacturers are well employed, as are the heavy electrical engineers, the jobbing foundries and the general engineers. The current figure for Derbyshire, Staffordshire and Lancashire brands of No. 3 for delivery to users in Lancashire is 78s. per ton, Northants being quoted at 77s. 6d. and Derbyshire forge at 74s. Scottish foundry iron is also dearer at about 83s., but East Coast hematite at 80s. 6d. to 81s., and West Coast at 81s., delivered in the Manchester area, are unchanged.

MIDLANDS.—Business has been very slack since the advent of the new prices, but this is not taken as a bad sign, as the majority of the consumers had previously covered their requirements for several months ahead. Consumption is reported to have been well maintained. The present controlled prices for Midland brands of foundry iron, which include delivery to Birmingham and Black Country stations, are 72s. 6d. for Northants No. 3 and 75s. for Derbyshire, Lincolnshire and North Staffordshire No. 3. These prices are less a small graduated rebate to large consumers. Forge iron continues to be quoted at 5s. per ton below the foregoing figures. Other qualities of iron remain in good demand, and prices have advanced. Low-phosphorus grades are about 90s. per ton delivered in the Midlands, while medium-phosphorus iron is 75s. to 87s. 6d. Refined pig-iron is unchanged, and prices range from £5 7s. 6d. to £7 10s. per ton delivered this district. The demand for hematite has increased during the past week, for consumers are taking additional cover in view of the prospect of advanced prices.

SCOTLAND.—Prices of Scottish foundry iron have been advanced along with those in other districts, the rise in this area being 4s. per ton. The official figure is now 74s. per ton f.o.t. furnaces, with 2s. 6d. extra for No. 1. Exporters are quoting 76s. 6d. for No. 1 and 75s. for No. 3 foundry, f.o.b. Glasgow. The light-castings makers continue to have satisfactory requirements of pig-iron, and some contracts have been arranged for delivery well into next year. Quotations for No. 3 Cleveland are higher at 70s. f.o.t. Falkirk and 73s. f.o.t. Glasgow. Local steelworks have placed orders for pig-iron for delivery up to the end of the first half of 1936.

Coke

The call for foundry coke continues to be heavy and, in some cases, delays in deliveries are being experienced. Many consumers are enlarging their stocks in view of the unsettled condition of the mining industry. For delivery at Birmingham and Black Country stations, best Durham coke is quoted at 37s. to 41s., while Welsh is on offer at from 33s. 6d. to 45s. per ton.

Steel

Busy conditions continue to rule in all departments of the steel market, and the contracts which have recently been taken assure the maintenance of the present state of activity for some months to come, says the official report of the London Iron and Steel Exchange. New business in the semi-finished steel department has been restricted by the difficulty of placing orders, as nearly all the producing firms have committed themselves as far ahead as they are willing to go. The recent shipbuilding orders have brought fresh business to the steelworks, and the demand from the constructional and other branches of the engineering trade is steadily expanding.

Scrap

Heavy melting-steel scrap continues to be available in the Cleveland market in small parcels at 52s. 6d. per ton delivered works. Machinery cast-iron scrap is in good demand at 55s. per ton, and up to 56s. 6d. has been paid. Clean light cast iron is at 43s. 6d. to 44s. The condition of the Midland market remains satisfactory and the demand is good at firm prices. The majority of the business is in small parcels for early delivery. Short, heavy steel scrap as used in the foundries is at 55s. to 57s. 6d. per ton delivered works. Business on the Yorkshire market is fairly brisk and the general tone is good. Fair quantities of steelworks heavy cast iron are being consumed at 49s. 6d. delivered, while foundry cast iron has a good demand at from 51s. to 55s. per ton. Quotations on the Scottish market are firm, and it would not be surprising if some advances were made in the near future. First-quality, heavy mild-steel melting scrap in furnace sizes is at 50s., and heavy basic or heavy iron and steel scrap mixed is at 45s. Heavy machinery cast-iron scrap is firm at 57s. 6d. to 60s.

Metals

Copper.—This market is quiet and rather featureless. According to the weekly review of the metal markets issued by Messrs. Rudolf Wolff & Company, "the market is still largely under the influence of the uncertainties surrounding the political situation in Europe, and which results in some restriction of business, for buyers and sellers alike in the circumstances adopt a cautious attitude. Consumption, however, is reported to be satisfactory, and as there would seem to be no likelihood of any modification in agreements recently reached by producing interests, the statistical position should continue to improve." The demand for copper has been small this week, but with the General Election out of the way it is hoped that there will be something of a revival.

Daily market prices :—

Cash.—Thursday, £35 8s. 9d. to £35 10s.; Friday, £35 8s. 9d. to £35 11s. 3d.; Monday, £35 3s. 9d. to £35 6s. 3d.; Tuesday, £34 18s. 9d. to £35; Wednesday, £35 to £35 1s. 3d.

Three Months.—Thursday, £35 16s. 3d. to £35 17s. 6d.; Friday, £35 16s. 3d. to £35 17s. 6d.; Monday, £35 11s. 3d. to £35 12s. 6d.; Tuesday, £35 6s. 3d. to £35 7s. 6d.; Wednesday, £35 7s. 6d. to £35 8s. 9d.

Tin.—Demand for this metal has been quiet, both in this country and on the Continent, but rather more activity has been seen in the United States. According to the "Metallgesellschaft," the world's mine output of tin during September was 9,839 metric tons, as compared with 12,030 metric tons in August and 12,996 metric tons in July. The chief cause of this reduction was the decrease in the Malayan and Bolivian outputs. There are to be further informal negotiations in connection with the renewal of the restriction scheme after the end of next year in London this week.

Cash.—Thursday, £226 to £227; Friday, £230 10s. to £233; Monday, £229 10s. to £230 2s. 6d.; Tuesday, £233 to £234; Wednesday, £237 10s. to £238.

Three Months.—Thursday, £213 5s. to £213 10s.; Friday, £214 5s. to £214 15s.; Monday, £213 to £213 10s.; Tuesday, £214 to £215; Wednesday, £215 5s. to £215 10s.

Spelter. — This market remains very much the same as last reported. Prices have shown a slight improvement. Brass makers continue to have excellent requirements, but the position of the galvanising industry remains unsatisfactory, though there is a slight increase in the demand from this quarter.

Official quotations were as follow :—

Ordinary.—Thursday, £16 10s.; Friday, £16 10s.; Monday, £16 10s.; Tuesday, £16 5s.; Wednesday, £16 5s.

Lead.—The Government's proposals contained in its development programmes in regard to roads and railways have acted as a stimulus to this metal. At present there is very little foreign lead entering this country, and, in some cases, consumers are finding it rather difficult to procure sufficient quantities to satisfy their needs.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £18 5s.; Friday, £18 5s.; Monday, £18 3s. 9d.; Tuesday, £18 2s. 6d.; Wednesday, £17 18s. 9d.

GANISTER

Purchase your supplies from actual Producers with over 50 years' reputation

Scientifically treated, specially ground Ganister for Cupolas, Iron & Steel Works, &c.

SPECIAL LADLE GANISTER

TRIAL BAGS FREE
Quotations on application

The ASTBURY SILICA CO.
CONGLETON, Cheshire
Est. 50 Years

IDAHO PINE
YELLOW PINE

PRIME & PATTERN GRADES
½" to 3" thick
Width up to 24" wide
All free of centre heart and shake

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facture of Ground Ganister

NOTHING BETTER FOR THE LINING OF CUPOLAS THAN A REALLY HIGH CLASS GROUND GANISTER HAS EVER YET BEEN DISCOVERED — CHEAP "PRICE CUT" RUBBISH IS DEAR AT ANY PRICE

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FINAL COST ——————————→ INFINITELY CHEAPER

With entire freedom from trouble and worry

ACTORIES LTD.

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Adelphi, W.C.

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GLASGOW OFFICE :
156, St. Vincent Street, C.2.

Telephone : Central 5250.
Telegrams : Genefax, Glasgow.

XUM

RAW MATERIALS—PRICE LIST

(Wednesday, November 13, 1935)

COPPER

	£ s. d.
Standard cash	35 0 0
Three months	35 7 6
Electrolytic	39 0 0
Tough	37 15 0
Best selected	38 5 0
Sheets	68 0 0
India	49 10 0
Wire bars	39 7 6
Ingot bars	39 7 6
H.C. wire rods	42 17 6
Off. av. cash, Oct.	35 5 2 3/16
Do., 3 mths., Oct.	35 12 5 3/16
Do., Sttlmnt., Oct.	35 5 2 1/4
Do., Electro, Oct.	39 19 4 3/16
Do., B.S., Oct.	39 1 4 3/16
Do., wire bars, Oct.	40 6 6 9/16
Solid drawn tubes	10½d.
Brazed tubes	10½d.
Wire	6½d.

BRASS

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	7½d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN

	£ s. d.
Standard cash	237 10 0
Three months	215 5 0
English	238 10 0
Bars	240 0 0
Straits (nom.)	239 15 0
Australian (nom.)	239 5 0
Eastern	227 0 0
Banca (nom.)	238 5 0
Off. av. cash, Oct.	227 8 10 3/16
Do., 3 mths., Oct.	217 9 1 3/16
Do., Sttlmt., Oct.	227 6 11 11/16

SPELTER

	£ s. d.
Ordinary	16 5 0
Remelted	15 10 0
Hard	13 10 0
Electro 99.9	18 17 6
English	17 7 6
India	14 15 0
Zinc dust	19 10 0
Zinc ashes	4 10 0
Off. aver., Oct.	16 11 1 9/16
Aver. spot, Oct.	16 8 9 5/16

LEAD

	£ s. d.
Soft foreign ppt.	17 18 9
Empire (nom.)	18 17 6
English	20 0 0
Off. average, Oct.	18 4 2 5/16
Average spot, Oct.	18 4 2 5/16

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	24 10 0
Do., V.M. ex-whse.	25 12 6
Rods	29 5 0

ANTIMONY

	£ s. d.
English	79 0 0 to 80 0 0
Chinese, ex-whse.	68 0 0
Crude, c.i.f.	36 0 0

QUICKSILVER

	£ s. d.
Quicksilver	11 15 0 to 12 5 0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	12 15 0
75%	17 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/6 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£18 0 0 to £20 0 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	33 0 0
4/6% car.	21 15 0
6/8% car.	21 0 0
8/10% car.	21 0 0
Ferro-chrome—	
Max. 2% car.	34 0 0
Max. 1% car.	36 5 0
Max. 0.70% car.	37 5 0
70% carbon-free	9½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to 11 5 0
76/80% packed	£11 15 0 to 12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

South Wales—	£ s. d.	£ s. d.
Heavy steel	2 17 6	to 3 0 0
Mixed iron and steel	2 14 0	to 2 15 0
Heavy cast iron	2 13 0	to 2 14 6
Good machinery	2 17 6	to 2 18 0

Cleveland—	
Heavy steel	2 12 6
Steel turnings	1 17 6
Cast-iron borings	1 7 6
Heavy cast iron	2 12 6
Heavy machinery	2 15 0 to 2 16 6

Midlands—	
Light cast-iron scrap	2 7 6
Heavy wrought iron	3 0 0
Steel turnings	1 15 6

Scotland—	
Heavy steel	2 10 0
Ordinary cast iron	2 13 0
Engineers' turnings	2 0 0
Cast-iron borings	1 17 6 to 2 0 0
Wrot-iron piling	3 0 0
Heavy machinery	2 2 6

London—Merchants' buying prices, delivered yard.

Copper (clean)	29 0 0
Brass	19 0 0
Lead (less usual draft)	15 15 0
Tea lead	12 0 0
Zinc	9 0 0
New aluminium cuttings	72 0 0
Braziery copper	26 0 0
Gunmetal	27 0 0
Hollow pewter	155 0 0
Shaped black pewter	120 0 0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	72/6
Foundry No. 3	70/-
,, at Falkirk	70/-
,, at Glasgow	73/-
Foundry No. 4	69/-
Forge No. 4	69/-
Hematite No. 1	71/-
Hematite M/Nos.	70/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	74/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	71/-
,, No. 3 fdry.	75/-
Northants forge	68/6
,, fdry. No. 3	72/6
,, fdry. No. 1	75/6
Derbyshire forge	71/-
,, fdry. No. 3	75/-
,, fdry. No. 1	78/-
Scotland—	
Foundry No. 1, f.o.t.	76/6
,, No. 3, f.o.t.	74/-
Hem. M/Nos. d/d	73/6
Sheffield (d/d district)—	
Derby forge	68/6
,, fdry. No. 3	72/6
Lincs forge	68/6
,, fdry. No. 3	72/6
W.C. hematite	86/-
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	78/-
Staffs fdry. No. 3	78/-
Northants fdry. No. 3	77/6
Cleveland fdry. No. 3	78/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/-
Clyde, No. 3	83/-
Monkland, No. 3	83/-
Summerlee, No. 3	83/-
Eglinton, No. 3	83/-
Gartsherrie, No. 3	83/-
Shotts, No. 3	83/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 12 6	to 9 15 0
Nut and bolt iron	7 17 6	to 8 7 6
Hoops	10 10 0	and up.
Marked bars (Staffs)	f.o.t. 12 0 0	
Gas strip	10 10 0	and up.
Bolts and nuts, ¾ in. × 4 in.	15 2 6	and up.

Steel—	£ s. d.	£ s. d.
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	9 5 0	to 9 7 6
Chequer plts.	10 7 6	
Angles	8 7 6	
Tees	9 7 6	
Joists	8 15 0	
Rounds and squares, 3 in. to 5½ in.	9 7 6	
Rounds under 3 in. to ⅜ in. (Untested)	8 12 0	
Flats—8 in. wide and over	8 12 6	
,, under 8 in. and over 5 in.	8 17 6	
Rails, heavy	8 5 0	to 8 10 0
Fishplates	12 5 0	to 12 10 0
Hoops (Staffs)	9 7 0	
Black sheets, 24g. (4-t. lots)	11 5 0	
Galv. cor. shts. (,,)	13 5 0	
Galv. flat shts. (,,)	13 15 0	
Galv. fencing wire, 8g. plain	14 10 0	
Billets, soft	5 10 0	and up.
Billets, hard	6 17 6	to 7 2 6
Sheet bars	5 10 0	to 5 12 6
Tin bars	5 10 0	to 5 12 6

PHOSPHOR BRONZE

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.31
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Malleable, Valley	18.50
Grey forge, Valley	18.00
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.90
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.40
Plain wire	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	20/- to 21/-
,, furnace	16/6 to 17/9
Scotland, foundry	28/-
,, furnace	25/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	18/9
,,	28×20 ,,	37/6
,,	20×10 ,,	27/-
,,	18¾×14 ,,	19/6
C.W.	20×14 ,,	15/6 to 15/9
,,	28×20 ,,	33/6 to 34/-
,,	20×10 ,,	22/9
,,	18¾×14 ,,	15/9

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 0 0 to £16 10 0
Bars and nail-rods, rolled, basis	£15 15 0 to £16 0 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£30 0 0 to £31 0 0
Faggot steel	£18 0 0 to £23 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£	s.	d.		
Nov. 7 ..	35	8	9	No	change
„ 8 ..	35	8	9	„	„
„ 11 ..	35	3	9	dec.	5/-
„ 12 ..	34	18	9	„	5/-
„ 13 ..	35	0	0	inc.	1/3

Electrolytic Copper

	£	s.	d.		
Nov. 7 ..	40	0	0	No	change
„ 8 ..	39	15	0	dec.	5/-
„ 11 ..	39	11	3	„	3/9
„ 12 ..	39	5	0	„	6/3
„ 13 ..	39	0	0	„	5/-

Standard Tin (cash)

	£	s.	d.		
Nov. 7 ..	226	0	0	inc.	20/-
„ 8 ..	230	10	0	„	90/-
„ 11 ..	229	10	0	dec.	20/-
„ 12 ..	233	0	0	inc.	70/-
„ 13 ..	237	10	0	„	90/-

Tin (English ingots)

	£	s.	d.		
Nov. 7 ..	226	10	0	inc.	20/-
„ 8 ..	230	10	0	„	80/-
„ 11 ..	229	10	0	dec.	20/-
„ 12 ..	234	0	0	inc.	90/-
„ 13 ..	238	10	0	„	90/-

Spelter (ordinary)

	£	s.	d.		
Nov. 7 ..	16	10	0	inc.	3/9
„ 8 ..	16	10	0	No	change
„ 11 ..	16	10	0	„	„
„ 12 ..	16	5	0	dec.	5/-
„ 13 ..	16	5	0	No	change

Spelter (Electro, 99.9 per cent.)

	£	s.	d.		
Nov. 7 ..	19	2	6	inc.	5/-
„ 8 ..	19	3	9	„	1/3
„ 11 ..	19	2	6	dec.	1/3
„ 12 ..	18	17	6	„	5/-
„ 13 ..	18	17	6	No	change

Zinc Sheets (English)

	£	s.	d.		
Nov. 7 ..	24	15	0	inc.	2/6
„ 8 ..	24	15	0	No	change
„ 11 ..	24	15	0	„	„
„ 12 ..	24	10	0	dec.	5/-
„ 13 ..	24	10	0	No	change

Lead (English)

	£	s.	d.		
Nov. 7 ..	20	5	0	inc.	5/-
„ 8 ..	20	5	0	No	change
„ 11 ..	20	5	0	„	„
„ 12 ..	20	5	0	„	„
„ 13 ..	20	0	0	dec.	5/-

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1899	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 6	3 6 2½
1900	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6	2 17 6	2 17 6	2 17 1½
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1½
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 10 10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6½
1928	3 13 2½	3 12 3½	3 12 3	3 12 3	3 11 6	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 7 6	3 9 10½
1929	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 0	3 13 1½
1930	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4½
1931	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 10
1932	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1933	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1934	3 7 0	3 9 6	3 13 2½	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 12 11½
1935	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	—	—	—

* No prices available during strike period.

WILLIAM JACKS & COMPANY,
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CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
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SITUATIONS VACANT AND WANTED

CUPOLA Backman, experienced, desires change; can take temporary charge; used to cupolas melting 4 to 8 tons per hr.—Box 438, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG MAN, single, age 29, desires position as foreman or assistant anywhere abroad. Experienced. Guaranteed to get results. Iron; semi-steel; jobbing. Repetition. —Box 454, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT Foundry Foreman required for large foundry in the Midlands making repetition precision castings in grey iron. Good opening for young man—preferably one who has had experience in machine moulding.—Box 462, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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WANTED.—Practical Foundryman to work snap-flask hand moulding machine in our ironfoundry for period of two weeks; must have previous experience of snap-flask work. Reasonable fee and expenses paid.—TONGE & TAGGART, LTD., Windmill Lane, Dublin.

ASSISTANT Patternshop Foreman required for large repetition foundry in the Midlands. Preference given to young man who has had experience in making pattern equipment for machine moulding, preferably for the motor trade.—Box 464, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

COREMAKER required; also three Moulders. State age, experience, and wages required to W. WILDER & SONS, LTD., The Iron Foundry Crowmarsh, near Wallingford.

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CHILLED and Grain Rolls, Rolling-Mill Plant, etc.—Specialist, well known throughout iron, steel and non-ferrous trades, with exceptional and important managerial experience in manufacturing and selling organisation, desires representation and consulting appointments with sound progressive firms Communications treated confidentially.—Box 456, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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FOR SALE.—One Jackman Junior Cupola in excellent condition; size No. "0"; capacity 10-15 cwts. per hr.; complete with motor-driven fan, 400 volts, 3 phase, 50 periods. For prices and particulars apply Box 452, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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300 cub. ft. cap. AIR COMPRESSOR; one stage; one cyl.; 12" x 12" str. belt dr.; 100 lbs. press.; Sullivan.

50-h.p. 400/450-volt 3-ph. 50-c. MOTOR, 600 r.p.m.; G.E.C.; slipring; tot. encl.

Two land-type "Stirling" Water-Tube BOILERS, each of 6,972 sq. ft. heating surface; 210 lbs. w.p.

Four "Hotchkiss" Feedwater CIRCULATORS.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

ONE new Cupola Installation by George Green, with cupola 3 ft. dia., complete with drop bottom, spark arrester, staging and motor-driven blower; absolutely new condition. Electrical equipment suitable for standard 3-phase current. Cheap to save removal.—ALEX. HAMMOND, Foundry Machinery Merchant, Slough.

THREE "Rapid" pneumatic Squeezers; plain-squeeze type; no pattern draw. Price £9 each.—ALEX. HAMMOND, Foundry Machinery Merchant, Slough.

TWO roller-bearing, double-ended Fettling-shop Grinders, complete with new wheels 24 in. by 3 in. on each machine. Thoroughly modern machines in perfect condition; as new. Offered cheap.—ALEX. HAMMOND, Foundry Machinery Merchant, Slough.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

SANDBLAST PLANTS

Room Plants, sizes 12 ft. x 12 ft., 12 ft. x 9 ft. and 6 ft. x 6 ft., made up in cast-iron sections.

Barrel Plants, 30 in. dia. x 36 in. long and 30 in. dia. x 18 in. long rotary barrels.

Cabinet Plants, in sizes 4 ft. x 4 ft. x 4 ft., 36-in. dia. and 30-in. dia. operators' cabinets.

Most of the above by Tilghman and complete with Air Compressors.

HAND MOULDING MACHINES

By Adaptable, Pridmore, Darling & Sellars, etc.; Squeezers by Utard (unused), Samuelson and Britannia, also Farwell Universal Type.

Ladles, Grinding Machines, Exhaust Fans, Blowers, Air Compressors and 500 Electric Motors and Dynamos.

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MISCELLANEOUS

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3-TON Avery Weighing Machine, with 24-in. gauge rails.

1-ton Avery Weighing Machine, ordinary platform type with modern steel yard; as new.

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5-cwt. Avery Weighing Machine, portable type with loose weights.

2-ton Avery Crane Weigher, dial type.

10-ton Denison Crane Weigher.

15-ton Denison Crane Weigher.

20-ton Denison Crane Weigher.

30-ton Denison Crane Weigher.

All above in stock, offered cheap. Re-stamped ready for use.

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MISCELLANEOUS—*Continued*

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BARREL PLANT by Tilghman, *as new*, 60" × 40". Price £240.

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Several small complete barrel plants in stock.

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